Data-Collection Technology

Vernier

MEASURE. ANALYZE. LEARN.™

Vernier

CATALOG
2015

Chemistry, Physics, Biology, STEM, Biotechnology
Engineering, Math, K–8, Physical Science, Physiology
Environmental Science, Water Quality, Earth Science

ONE OF 100 BEST COMPANIES TO WORK FOR IN OREGON

PLACED 2ND 2014 HEALTHIEST EMPLOYERS

PLACED 17TH OF 100 BEST GREEN COMPANIES IN OREGON

PLACED 18TH TOP WORKPLACES IN OREGON

BUSINESS JOURNAL CORPORATE PHILANTHROPY AWARD FOR 2014

VERNIER IS PROUD TO BE RECOGNIZED FOR ITS PHILANTHROPIC COMMITMENT, ENVIRONMENTAL POLICIES, STEADY GROWTH, AND AS ONE OF THE BEST 100 COMPANIES TO WORK FOR IN OREGON FOR 14 YEARS.

Innovating for STEM Education

When people ask us what our company does, we often tell them, "We provide a way for teachers to collect data with whatever technology they want to use." Over the years, that technology has changed a lot. Last year, teachers told us they wanted more support for Chromebooks. In response, we introduced Graphical Analysis for Chrome OS and added support to our web app for our Go!Temp, Go!Motion, and Go!Link. These provide an easy-to-use, inexpensive sensor solution for the many schools that are adopting Chromebooks or iPads.

We have a lot of great new products this year, but one leads to a personal note from David: When I was a physics teacher (see photo), I ran a bridge-building contest every year, and it was a huge hit. It got so popular that it was difficult to test all the bridges. I tried every method I could think of to apply the force in a measured way. Nothing worked well, until I finally learned to use strain gages, and I built an apparatus connected to an Apple II computer to measure the force as it was applied by a jack. This experimentation was a key step in the start of this company. Now that we are introducing our Vernier Structures & Materials Tester, it seems that things are coming full circle.

If you find yourself in the Portland, Oregon area, we encourage you to stop in and see the new building addition to our office, with an improved classroom and other facilities to allow us to better handle workshops.

As always, we encourage you to give our products a try on a 30-day (or longer) preview basis. Feel free to personally contact either of us at any time.

Dave and Christine Vernier
dvernier@vernier.com and cvernier@vernier.com

VERNIER SOFTWARE & TECHNOLOGY

Vernier Software & Technology was co-founded in 1981 by Dave and Christine Vernier. Dave's background as a physics teacher and Christine's knack for business combined to form a company with a deep commitment to education.

Thirty-four years later, the company is still owned by Christine and Dave, along with 8 employee owners who have backgrounds in science and math education, as well as business.

Chromebook data collection using Go!Temp, Vernier's USB-direct temperature probe

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What's NEW

Data Collection for Tablets and Mobile Devices

Check out the new solutions we've developed for iPad® devices, Android™ tablets, Chromebooks™, and BYOD.

TABLET-BASED DATA COLLECTION PAGES **6–9**

NEW WIRELESS SENSORS AND INTERFACE
PAGES **10–13**

NEW CHROMEBOOK DATA COLLECTION
PAGES **14–15**

APPS FOR TABLETS PAGE **6**

NEW Graphical Analysis™ for iOS, Android, and Chrome – View and analyze data from Vernier sensors with this free app.

Video Physics™ – Perform video analysis on the iPad, iPhone®, and iPod touch®.

NEW Go Wireless® Link

Coming in 2015! Make many of your existing Vernier sensors wireless with our new Go Wireless Link. This new, single-channel interface wirelessly transmits data to your tablets and other mobile devices.

PAGE **10**

NEW Go Wireless® pH

Wirelessly transmit pH data to your iPad or LabQuest 2 using Go Wireless pH. Students can study the pH of household acids and bases, conduct acid-base titrations, perform water quality tests, and much more!

PAGE **12**

NEW Go Wireless® Heart Rate

Using our Go Wireless Heart Rate, students can continuously monitor heart rate before, during, and after exercise or while stationary. Data are wirelessly transmitted to iPad, LabQuest 2, or other mobile devices.

PAGE **12**

NEW Structures & Materials Tester

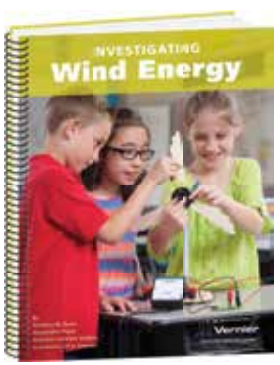
Perfect for bridge competitions! Use the Structures & Materials Tester, along with the engineering design method, to design, build, and test structures and investigate and analyze beam designs and material properties.

PAGE **71**

NEW Fan Carts

Students can use this lightweight cart with its built-in fan to perform kinematics and dynamics experiments with constant acceleration, variable mass, variable thrust, and variable thrust angle.

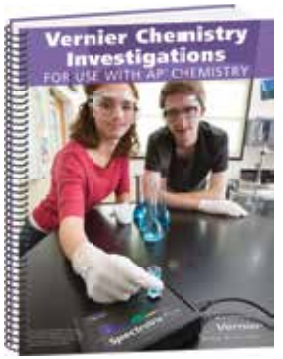
PAGE **112**



NEW *Investigating Wind Energy* Lab Book

Written for and aligned with NGSS! The investigations in this lab book encourage students to apply learned knowledge as they explore electric circuits and investigate blade design variables. The culminating engineering project asks students to design, test, and refine a wind turbine blade set.

PAGE **92**



NEW *Vernier Chemistry Investigations for Use with AP* Chemistry* Lab Book

AP chemistry students can now collect and analyze scientific data using Vernier sensors for the 16 inquiry-based laboratory experiments required by the College Board.

PAGE **52**

*AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.

NEW Celestron Digital Microscope Imager

Instantly display digital images on a computer or Chromebook! The Celestron Digital Microscope Imager turns your traditional compound or stereo microscope into a high-resolution digital imager. Students can take still photos, movies, and even time-lapse videos.

PAGE **48**

NEW Vernier Energy Sensor

The Vernier Energy Sensor offers an easy way to quantify voltage, current, power, and energy output of small wind turbines and solar panels, such as those used in our KidWind Experiment Kits.

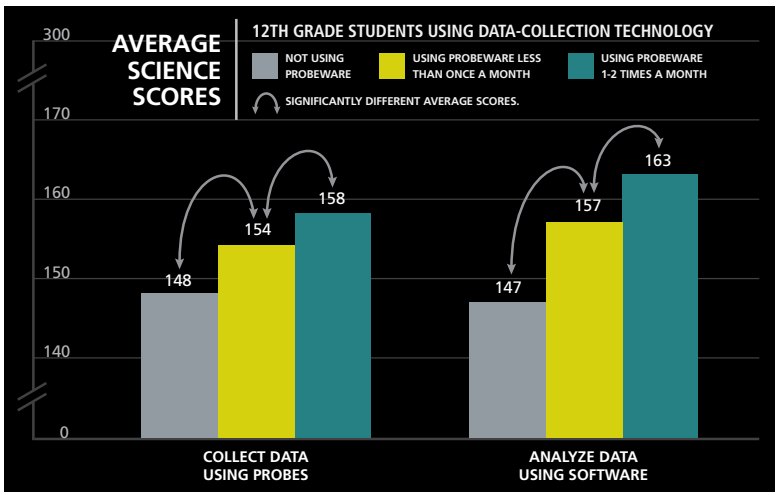
PAGE **83**

Why Vernier?

Why Teachers Choose Vernier

Worldwide, educators tell their colleagues about Vernier. Here's why teachers recommend Vernier's data-collection technology.

Improves test scores



Source: The 2000 NAEP Science Assessment. This study of 49,000 U.S. students shows that students who used probeware to collect and analyze data scored significantly higher on tests than those who did not.

Get details at **www.vernier.com/research**

Creates a deeper understanding of science concepts

"Students using data logging probes along with the LabQuest software allows teachers to plan lessons that make abstract ideas concrete and enables students to access complex and interesting science in ways that we were previously unable to. Our students are very confident in using the technology. It is clear to me that of all the things we have done to improve the quality of science education, the implementation of the Vernier technology has been the most significant."

Stephen Daly, Riyadh Schools, Riyadh, Saudi Arabia

Supports Next Generation Science Standards (NGSS) and state standards

"When you teach students how to use a probe, they can quickly jump ahead with doing real science. Once they understand what the motion detector does, for example, they can develop questions about velocity and acceleration and then use the detectors to find the answers, analyze a lot of data efficiently, and use their data and graphs to communicate their results. They apply several of the NGSS practices in each lab, and they think it's really cool, too, so I'm sneaking in a lot of learning while they're having fun."

Ann Hammersly, Chaparral High School, Scottsdale, Arizona

Allows more time for teaching and learning

"Vernier's range of compatible sensors available was extensive. … We have found the equipment extremely useful in demonstrating to pupils how our simplistic experiments relate to, and might be conducted, in industry. In some of our experiments, the equipment provided more teaching time without taking the practical element of the sciences away. The LabQuest 2 has also allowed us to carry out meaningful experiments that we have not been able to do before."

Chris Jessop, AKS School, Lytham, United Kingdom

Download Vernier's white paper on probeware and student performance
www.vernier.com/whitepaper

Promotes scientific inquiry

"The LabQuest 2 from Vernier is an outstanding tool to engage students in scientific inquiry. In my opinion, its reasonable price and ease of use make the LabQuest 2 a valuable tool for students conducting scientific investigations. It can help motivate them toward greater scientific achievement."

Edwin Christmann, Slippery Rock University, Slippery Rock, Pennsylvania

Designed to be easy to use

"The Scottish Advanced Higher Chemistry course requires pupils to carry out a 20 hour project independently. Many of them carry out investigations on colour chemistry, and it was for this reason that I decided to purchase two LabQuest 2 devices. … They are robust and extremely user friendly. Students found them easy to use and gave them results that could be inserted into their writeup."

J Anderson, St Aloysius' College, Glasgow, United Kingdom

Builds student interest in science

"Vernier's LabQuest 2 can build interest in science, make experiments come alive, and deepen understanding of complex concepts. The affordable handheld tool supports student-centered, inquiry-based learning, high-end data collection, and critical analysis as budding scientists use real tools to conduct real-time investigations of natural phenomena."

Carol Holzberg, Greenfield Public Schools, Greenfield, Massachusetts

Backed by unmatched training and technical support

"This message is to thank you and Vernier for your incredibly helpful service and prompt repair of our equipment. I wish all companies operated like Vernier!"

Betsy Barnard, Madison West High School, Madison, Wisconsin

"You folks at Vernier have some of the most supportive, helpful, and friendly tech support I've ever dealt with, and it's always a pleasure."

Doug Alexander, Lincoln School, Providence, Rhode Island

"You guys are awesome! I can't get my own mom to reply back faster than that. … Thanks again."

Michael Strange, Mansfield High School, Mansfield, Texas

"Thanks for all of your hard work and innovation. Your company truly understands science education from the teacher's perspective, and my colleagues and I agree that Vernier is the most teacher-friendly company we have ever worked with."

Dana Munn, Martha's Vineyard Regional High School, Oak Bluffs, Massachusetts

"My experience on the phone with the staff at Vernier has been outstanding. I always feel like focus is on creating a lifelong customer (and it's working)."

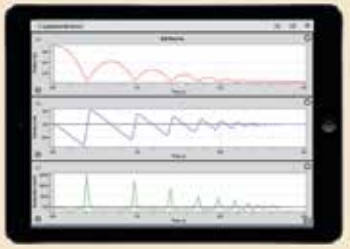
Megan Knight, Richmond Montessori School, Richmond, Virginia

"I am astounded. Being brand new to this whole probeware business, I am sitting here updating my nine LabQuests at lightning speed with my USB and the lab that I copied directly from the CD that came with my curriculum. You guys have got this down. I can't believe I even considered going with the competition. Well done!"

Jim Eisentrager, Marsing Middle School, Marsing, Idaho

Vernier Apps for iOS, Android, and BYOD

iPAD



iPad with Graphical Analysis

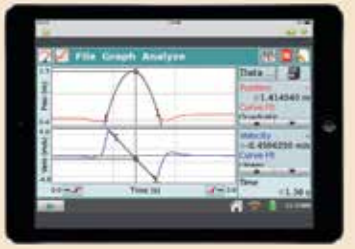
GRAPHICAL ANALYSIS™ FOR iPad®, iPhone®, AND iPod touch®

Graphical Analysis helps iPad-using students visualize experimental results by analyzing, annotating, and graphing that data on their devices. Data is received on the iPad from a Data Sharing source, such as the LabQuest 2 or Logger *Pro*. See page 9 or **www.vernier.com/ga-app**

iPad with Video Physics

VIDEO PHYSICS™

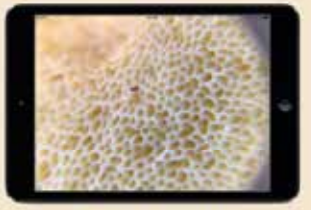
Video Physics brings powerful video capture and analysis to iPad, iPhone, and iPod touch. Video Physics was updated in August 2014 to include enhanced object tracking. This feature greatly enhances ease of use; it is easier to mark points, to delete points, adjust the origin, and set the scale. See page 32 or **www.vernier.com/video-physics**



iPad with LabQuest Viewer

LABQUEST VIEWER®

Turn any classroom with a LabQuest, iPad, and projector into a shared learning environment by using this app to project and control a LabQuest screen. With this app, educators can also monitor individual student's LabQuest screens. See page 32 or **www.vernier.com/lq-view-ipad**



iPad Mini with ProScope Micro Mobile

PROSCOPE™ MICRO MOBILE

Turn your tablet into a microscope. ProScope Micro Mobile is the first professional-level microscope for use with mobile devices in science education. Models are available for iPhone, iPod touch, iPad, and iPad mini. See page 48 or **www.vernier.com/bd-pmm**

ANDROID

Nexus 7™ with Graphical Analysis

GRAPHICAL ANALYSIS FOR ANDROID™

Graphical Analysis helps students visualize experiment results by analyzing, annotating, and graphing that data on their Android devices. Data are received from a Data Sharing source, such as LabQuest 2 or Logger *Pro*. Graphical Analysis for Android is available on Google Play. See page 9 or **www.vernier.com/ga-app**

FREE BYOD APPS

Tablet and phone with Vernier Data Share

VERNIER DATA SHARE WEB APP

Ideal for a bring-your-own-device environment, Vernier Data Share supports iPad, iPhone, iPod touch, Android phones and tablets, Chromebooks, notebook computers, and more. Students can use various compatible devices to collect, graph, and analyze data. Free app; no store download required. See page 9 or **www.vernier.com/data-share**

Choose LabQuest 2 and the Connected Science System® OR Wireless Sensors

LABQUEST 2 AND THE CONNECTED SCIENCE SYSTEM

Full Support for Vernier Sensors

With the Connected Science System and LabQuest 2, students can share and analyze real-time data on any number of mobile devices, creating a truly hands-on, collaborative learning environment. The LabQuest 2 is compatible with all of Vernier's sensors, providing schools long-term value with their existing sensors. LabQuest 2 can also be used as a standalone device or connected to a computer.

Wondering how it works? See pp. 8–9 or **www.vernier.com/connected-science-system**

OR

WIRELESS SENSORS AND GO WIRELESS® LINK

Connect Wirelessly to Your Tablet

These high-quality, yet affordable, data-collection devices are changing the way students collect scientific data during classroom investigations.

Go Wireless Link – Coming in 2015! Make many of your existing sensors "wireless" with our new Go Wireless Link. Perfect for use with tablets. See page 10 or **www.vernier.com/gw-link**

Go Wireless Temp – Ideal even for young learners, this durable, easy-to-use stainless-steel temperature probe is the perfect solution for tablet-based data collection. See page 11 or **www.vernier.com/gw-temp**

Go Wireless pH – Go Wireless pH is a general-purpose, wireless pH sensor you can use to remotely monitor pH. Great for use with iPad and other Bluetooth® Smart ready devices. See page 12 or **www.vernier.com/gw-ph**

Go Wireless Heart Rate – Using our Go Wireless Heart Rate, students can continuously monitor heart rate before, during, and after exercise. A perfect solution for tablet-based data collection. See page 12 or **www.vernier.com/gw-hr**

NODE – NODE is a wireless sensor platform developed by Variable, Inc. It has several built-in sensors and supports a variety of interchangeable sensor modules. See page 13 or **www.vernier.com/node**

Go Wireless Link *Go Wireless Temp* *Go Wireless pH* *Go Wireless Heart Rate* *NODE*

LABQUEST® 2
CONNECTED SCIENCE SYSTEM®

How It Works

1. Students in a lab group set up an experiment with Vernier sensors and LabQuest 2.
2. Students use a Data Sharing app to wirelessly start data collection.
3. Experiment data is streamed from LabQuest 2 to each student's Data Sharing app.
4. Each lab group member performs an individual analysis on their Data Sharing app.
5. Students take their data and analysis home with the Data Sharing app for further analysis and use in a lab report.

TEACHERS

- Use a robust data-collection system that is compatible with tablet-based, Chromebook, and bring-your-own-device (BYOD) classrooms
- Have the flexibility to use LabQuest 2 with iPad®, Chromebook™, Android™, and other mobile devices, as well as to use it as a standalone device or with computers
- Are supported by Vernier's extensive video training library
- Have access to Vernier's world-class technical support that includes both former science teachers and technology experts
- Benefit from dozens of standards-aligned lab books that include teacher notes, safety precautions, and detailed technology instructions

STUDENTS

- Wirelessly collect scientific data using a variety of sensors and digital tools
- Analyze an individual copy of collected data
- Annotate data, perform curve fits, and make statistical calculations to build evidence of personal understanding
- Tap, drag, pinch, and stretch graphs in an immersive, multi-touch environment
- Create a lab report or submit data to the teacher via email, camera roll, print function, and even third-party apps for notes and reports

What You Need

1. DATA SHARING SOURCE

LabQuest 2 Interface

The wireless capabilities of LabQuest 2 allow lab groups to stream sensor data to computers, tablets, and mobile devices.

- Compatible with all Vernier sensors
- Supports multiple sensors simultaneously
- Simultaneously stream data to multiple Data Sharing apps (via Wi-Fi)

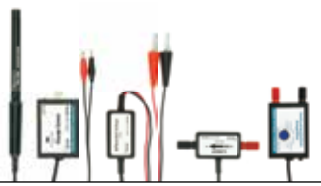
OR

Computer

For data sharing with a computer, go to **www.vernier.com/data-sharing/sources/**

2. SENSORS

Choose from 88 sensors for Chemistry, Biology, Physics, STEM, Math, K–8, Water Quality, Physiology, Physical Science, Environmental Science, Renewable Energy, and Earth Science.
See pp. 140–162

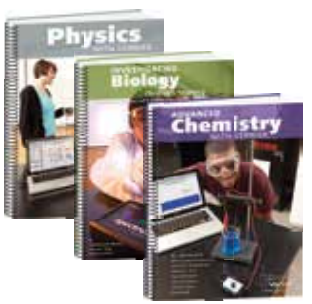


3. LAB IDEAS

Vernier lab books include lab ideas for science experiments integrated with data-collection technology. Each book includes

- Essential teacher information including teaching tips
- Editable student pages to modify labs to match your technology (Microsoft® Word® files for all student pages are provided on CD.)
- Suggested answers, sample data, and graphs

See pp. 122–131



4. DATA SHARING APPS

Graphical Analysis™ App

With the free Graphical Analysis app, teachers and students can

- Automatically detect Data Sharing sources on the network
- Simultaneously connect multiple devices running the Data Share app to the same Data Sharing source
- Collect data from built-in accelerometers
- Individually analyze and annotate data
- Auto-save work
- Export graphs or data to other apps
- Send graphs or data to the teacher

available in the chrome web store

Download on the App Store

ANDROID APP ON Google play

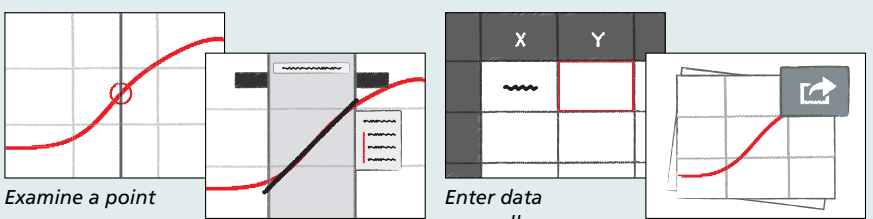
AND/OR

Vernier Data Share Web App

With Vernier Data Share, teachers and students can

- Simultaneously connect multiple devices to the same Data Sharing source
- Perform data collection and analysis in the browser—no store download required
- Individually analyze and annotate data
- Work in offline mode
- Save graphs and data to the device for use in other apps, email, or printing

No app download required



Examine a point

Select a range, annotate, and apply fits

Enter data manually

Export graphs and data

Go Wireless®

Introducing Go Wireless Sensors and the Go Wireless Link

Vernier Go Wireless sensors are rugged, general-purpose, wireless sensors you can use with iPad®, Android™ tablets, smart phones, and LabQuest 2. These Bluetooth® Smart sensors are perfect for science fair experiments, monitoring environmental conditions, and much more.

Collect data using our free Graphical Analysis app for iPad, iPhone®, iPod touch®, and Android devices or our LabQuest App for LabQuest 2. These apps allow students to view live readings, capture data in real time, calculate statistics, and curve fit the data.

Graphical Analysis app

Download Graphical Analysis

Download on the App Store

GET IT ON Google play

NEW GO WIRELESS LINK

Coming in 2015!

Looking for an affordable way to use Vernier sensors with tablets and other mobile devices? Now you can "go wireless" with one of our many existing sensors using our new Go Wireless Link. For more information, including a complete list of supported sensors, visit **www.vernier.com/gw-link**

GO WIRELESS CHARGING STATION

ORDER CODE **GW-CRG, $40**

The Go Wireless Charging Station is the perfect solution for charging and storing your Go Wireless devices. Each charging station has eight charging slots. **www.vernier.com/gw-crg**

Investigating freezing point depression with Go Wireless Temp

"The device and app make the Go Wireless Temp a highly desirable product for teachers looking for new ways to engage students in recording temperature."

Peter Griffiths, *Tech & Learning,* May 2014

"While the merits of digital temperature probes are well known and the benefits of wireless peripherals have pushed the collaboration and creativity in the science classroom, the Go Wireless Temp has added a new dimension with its light weight, free app, and 30 meter range."

Martin Horejsi, *NSTA Blog,* March 2014

Go Wireless Temp

a. Go Wireless Temp

ORDER CODE **GW-TEMP, $75**

Go Wireless Temp is watertight and accurate. It can be used inside or outside, rain or shine—wherever your experiments take you. With Go Wireless Temp, students can explore

- Endothermic and exothermic reactions
- Freezing and melting of water
- Energy content of foods
- Temperature in a fish tank or greenhouse
- … and much more!

PRODUCT SPECIFICATIONS

Temperature range: –40 to 125°C
Resolution: 0.07°C
Accuracy: ±0.5°C

WHAT'S INCLUDED

Sensor includes a USB charging cable*, a quick-start guide, the free Graphical Analysis app (available on the App Store and Google Play), and an online user manual.

Go Wireless Temp is compatible with LabQuest 2 (Model: LQ2-LE)

* Go Wireless Temp can be charged by connecting the included charging cable to a computer USB port or USB wall adapter (not included).

b. Go Wireless Temp Teacher Pack

ORDER CODE **GW-TEMP-TP, $570**

Save $70 by purchasing the Teacher Pack, which includes eight Go Wireless Temp probes and a Go Wireless Charging station.

a $75

b $570

NEW
$99
a

NEW
$79
b

NEW
$89
c

a. NEW Go Wireless pH, ORDER CODE **GW-PH, $99**

Go Wireless pH is a versatile pH sensor perfect for anyone wanting to do wireless pH measurements using supported Bluetooth® Smart ready devices, such as LabQuest 2 (Model: LQ2-LE) or iPad® (third generation or newer).

NEW Go Wireless pH Teacher Pack
ORDER CODE **GW-PH-TP, $760**

The Teacher Pack includes eight Go Wireless pH sensors and a Go Wireless Charging Station.

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b. NEW Go Wireless Electrode Amplifier
ORDER CODE **GW-EA, $79**

The Go Wireless Electrode Amplifier is a wireless mV and pH amplifier that connects to Vernier electrodes and compatible third-party BNC electrodes.

The BNC connector provides you the flexibility to choose among Vernier's pH, Flat pH, ORP, and most third-party electrodes to best fit your curriculum. You can expand your experiment options with additional electrodes in the future as your budget and needs grow. When the electrodes expire or if they are damaged in class, you only need to replace the electrode, lowering your costs.

---

c. NEW Go Wireless Heart Rate, ORDER CODE **GW-HR, $89**

The Go Wireless Heart Rate is ideal for continuously monitoring heart rate before, during, and after exercise or while a person is stationary. Data are wirelessly transmitted to iPad, LabQuest 2, or other mobile devices that are Bluetooth Smart ready.

Investigating household acids and bases with Go Wireless pH

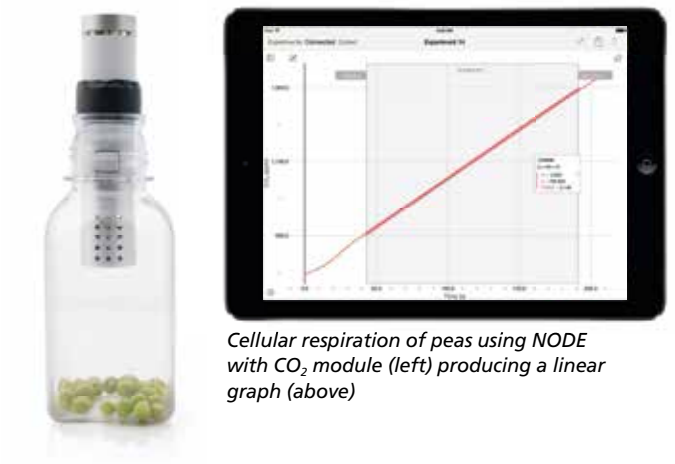
Did you know?

You can now use Go Wireless sensors with older LabQuest 2 units (Model: LabQuest 2). The Go Wireless USB Radio (GW-RADIO, $29, sold separately) allows any LabQuest 2 to work with Go Wireless sensors.

LabQuest 2 Model: LQ2-LE already works with Go Wireless sensors; no additional radio is required.

For information on how to determine which LabQuest 2 model you have, see **www.vernier.com/til/3085**

Simple harmonic motion with the NODE Sensor Platform



Cellular respiration of peas using NODE with CO_2 module (left) producing a linear graph (above)

NODE from Variable, Inc.

a. NODE Wireless Sensor Platform
For iOS, ORDER CODE **NODE-IOS, $99**
For iOS/Android, ORDER CODE **NODE-IA, $149**

NODE is a wireless sensor platform controlled by a mobile device. The NODE Wireless Sensor Platform includes a 3-axis gyroscope, accelerometer, and magnetometer. Also included are two expansion ports where additional NODE sensor modules can be attached.

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b. CLIMA NODE Module, ORDER CODE **NODE-CLIMA, $50**

This module measures humidity, temperature, light level, and barometric pressure.

---

c. THERMA NODE Module, ORDER CODE **NODE-THERMA, $75**

This module is an infrared temperature sensor that measures surface temperature from a distance up to 15 feet.

---

d. NEW CO_2 NODE Module, ORDER CODE **NODE-CO2, $149**

This module measures CO_2 gas concentrations in air. Use it to study cellular respiration or photosynthesis.

---

e. NEW Thermocouple NODE Module
ORDER CODE **NODE-TCA, $85**

This module measures temperature over a wide range from –200 to 1200°C using a type K thermocouple wire.

For more information, including options for software support and sample experiments, visit **www.vernier.com/node**

a

b $50

c $75

d NEW $149

e NEW $85

Chromebook™ Data Collection and Analysis

Robust Features, Lightweight Price

Now you can use your Chromebook's USB port for data capture with Vernier sensors

Schools purchased over a million Chromebooks in 2014, and these inexpensive, hassle-free machines are fast becoming a go-to mobile device in the classroom. Developed specifically for the Chrome™ operating system, our new app, Graphical Analysis for Chrome, makes it easy to collect and share data. Schools have been using LabQuest 2 to wirelessly stream data to Chromebooks, but now you can also connect our USB technology (Go!Temp, Go!Motion, and Go!Link) directly to your Chromebook device. It doesn't get any easier or more affordable than that!

Chromebook support for Go!Link using many existing Vernier sensors will be available late spring.

NEW GRAPHICAL ANALYSIS™ FOR CHROME

The Graphical Analysis app allows students to collect real-time sensor data using a Chromebook for analysis and sharing in the classroom. Graphical Analysis facilitates hands-on learning with tools that allow students to work with data in tables, calculate statistics, or perform curve fits. Students can easily create and send a finished lab report to their instructor, save their work to Google Drive™, or export data to Plotly™ for further study.

FEATURES

- Import and work with sensor data in graphs or tables
- Perform curve fits, including linear, quadratic, or natural exponent
- Create and edit graph titles; annotate data
- Send finished reports to an instructor
- Export graphs and data

www.vernier.com/ga-chrome

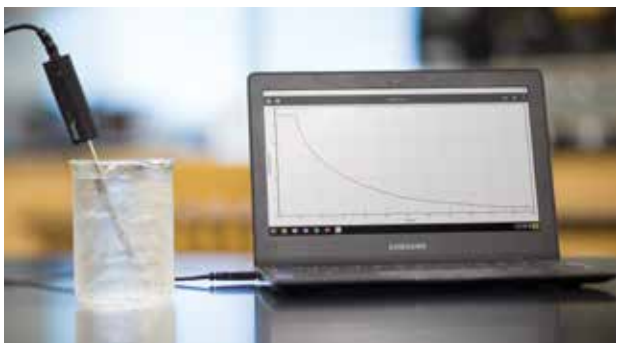
available in the chrome web store

NEW Chromebook USB Data Capture

Direct connection to Chromebook USB – Use any Chromebook loaded with Graphical Analysis for Chrome for an easy and affordable way to collect and analyze sensor data.

Go!Temp® or **Go!Motion**® – Plug either of these USB sensors directly in to your Chromebook to collect and analyze data using Graphical Analysis.

Go!Link® – Go!Link USB interface enables direct connection of many existing Vernier sensors to your Chromebook. Chromebook support for Go!Link available in spring.



Investigating cooling rates using a Chromebook and a Go!Temp

Did you know?

Use LabQuest 2 with Your Chromebook

You can wirelessly link multiple Chromebooks with a single LabQuest 2. Use LabQuest 2 to wirelessly collect and stream data to each Chromebook in a lab group. Your students can use Graphical Analysis for Chrome to independently analyze data and to create lab reports. Use LabQuest 2 with 88 Vernier sensors. Students can run experiments with multiple sensors. You can even share data from a computer running Logger *Pro* software with Chromebook devices in your classroom. More details about LabQuest 2 and the Connected Science System on pp. 8–9.

a. Go!Motion, ORDER CODE GO-MOT, $109

USB Motion Detector

- Teach important concepts in physics and physical science, such as position, velocity, and acceleration.
- Study the motion of a ball tossed in the air or a cart on a ramp.
- Engage your students with hands-on activities.
- Connects directly to your Chromebook's USB port. No additional interface required.

Teacher Pack of 8 Go!Motions
ORDER CODE GO-MOT-TP, $846

---

b. Go!Temp, ORDER CODE GO-TEMP, $39

USB Temperature Probe

- Engage your students with hands-on science as they explore temperature investigations.
- Rugged, stainless-steel temperature probe makes for easy data collection.
- Collect temperature data for only $39!
- Connects directly to your Chromebook's USB port. No additional interface required.

Teacher Pack of 8 Go!Temps, ORDER CODE GT-TP, $299

---

c. Go!Link, ORDER CODE GO-LINK, $61

USB Interface

- Go!Link is a quick and affordable way to get started with data-collection technology.
- Single-channel interface connects any one of many Vernier sensors to your Chromebook's USB port.
- Dozens of experiments can be conducted using Go!Link.

Teacher Pack of 8 Go!Links, ORDER CODE GL-TP, $473

NEW Chromebook support for Go!Link coming spring.

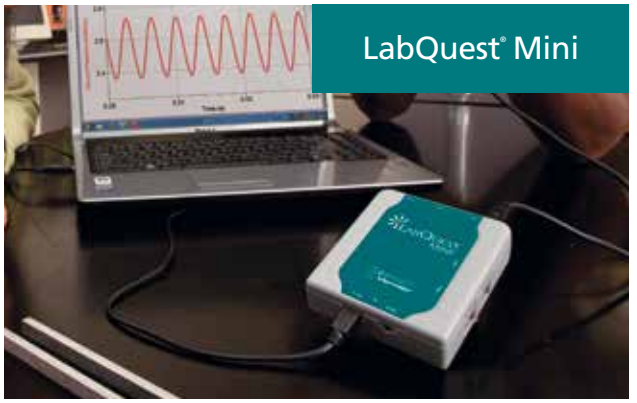
MORE ONLINE – For a list of compatible sensors, go to **www.vernier.com/go-link**

a $109

b $39

c $61

INTERFACE CHOICES



INTERFACES—COMPATIBILITY / PRICE CHART

CHOICES		SUPPORTED PLATFORMS	MAXIMUM SAMPLING RATE	COMPATIBLE VERNIER SENSORS	REMOTE DATA COLLECTION	BUILT-IN COLOR SCREEN	RECHARGEABLE BATTERY	BUILT-IN SENSORS	SUPPORTS MULTIPLE SENSORS	SOFTWARE	STANDARDS-BASED LABS
LabQuest 2 $329 ORDER CODE **LABQ2** See pp. 17–23		Standalone Computers Tablets Mobile Devices	100,000 per second	88 sensors See page 22 for a compatible sensor list	Built-in	Yes	Yes	Temperature Microphone GPS Accelerometers Light	Yes	Built-in LabQuest and other applications See pp. 19–21 Logger Lite (free download) Logger *Pro* (sold separately) See pp. 28–31	100 included labs 300+ more available on website 400+ labs available in print See page 130
LabQuest Mini $149 ORDER CODE **LQ-MINI** See pp. 24–25		Computers	100,000 per second	72* sensors See page 25 for a compatible sensor list	With a laptop computer	No	No batteries needed (USB powered)	None	Yes	Logger Lite (free download) Logger *Pro* (sold separately) See pp. 28–31	300+ more available on website 400+ labs available in print
Go!Link $61 ORDER CODE **GO-LINK** See page 26		Computers	200 per second	56* sensors See page 26 for a compatible sensor list	With a laptop computer	No	No batteries needed (USB powered)	None	No	Logger Lite (free download) Logger *Pro* (sold separately) See pp. 28–31	300+ more available on website 400+ labs available in print

COMING IN 2015: Go Wireless Link, a new wireless interface that lets you wirelessly use many of your existing sensors with tablets and other mobile devices. Visit **www.vernier.com/gw-link**

* Count does not include 12 USB or Bluetooth® sensors that connect directly to the computer and can be used in a computer-based lab station.

FOR TI CALCULATOR-BASED DATA COLLECTION: see pp. 132–137

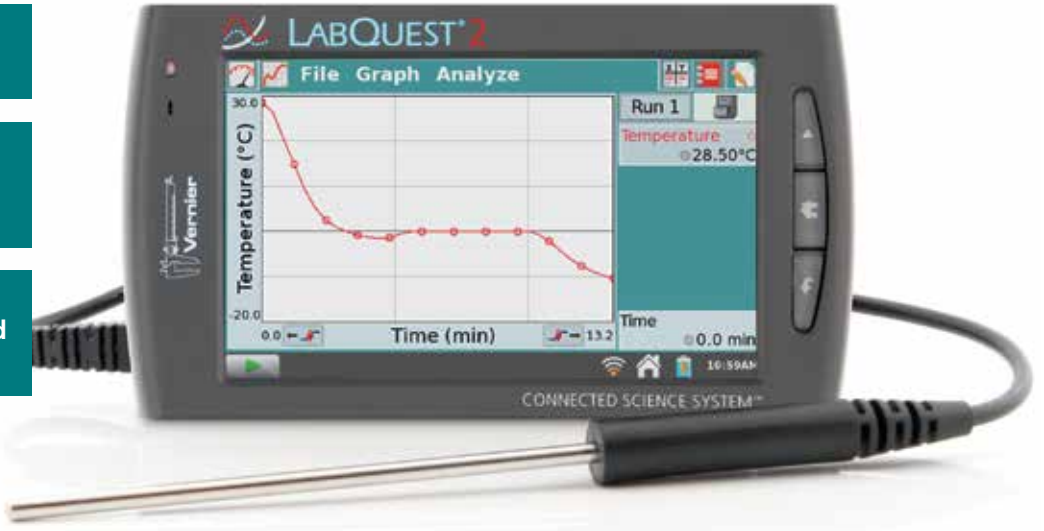
Meet LabQuest® 2

The most powerful, connected, and versatile data-collection device available for STEM education

Use as a standalone device

Use as a USB interface for computers

Wirelessly stream data to tablets and mobile devices



AWARD-WINNING TECHNOLOGY

Worlddidac Award granted to both LabQuest 2 and the Connected Science System

Readers' Choice Award from eSchool Media awarded to LabQuest 2

CODiE Award Finalist presented to the LabQuest 2 App

BETT Award Finalist presented to the LabQuest 2 App

READ THE REVIEWS

Tech & Learning – "Vernier's LabQuest 2 can build interest in science, make experiments come alive, and deepen understanding of complex concepts. The affordable handheld tool supports student-centered, inquiry-based learning…and critical analysis as budding scientists use real tools to conduct real-time investigations. …"
– Carol S. Holzberg, Ph.D.

Assistive Technology – "With the LabQuest 2, Vernier has transformed the way teachers need to think about teaching science in the classroom and provided them with an easy and powerful solution for capturing data in real time."
– Brian Friedlander, Ph.D.

Scholastic Administrator's Tech Tools – Grade: A, "A bargain. LabQuest is a modern-day science lab that fits in the palm of a hand." – Brian Nadel

NSTA Blog – "It seemed obvious that the LabQuest 2 would be a real game changer in the data-collection space, but after our field test, it seems more that the LabQuest 2 has invented an entirely new game."
– Martin Horejsi

Read the full reviews of LabQuest 2 and the Connected Science System at **www.vernier.com/labquest2**

LABQUEST® 2
CONNECTED SCIENCE SYSTEM®

$329
ORDER CODE
LABQ2

Meet LabQuest 2

The most powerful, connected, and versatile interface ever

- Use as a standalone device with 88 Vernier sensors including our Go Wireless® sensors.
- Connect to a Windows or Macintosh computer for use with Logger *Pro*.
- Stream data wirelessly to iPad® devices, Chromebooks™, Android™ tablets, and other mobile devices.

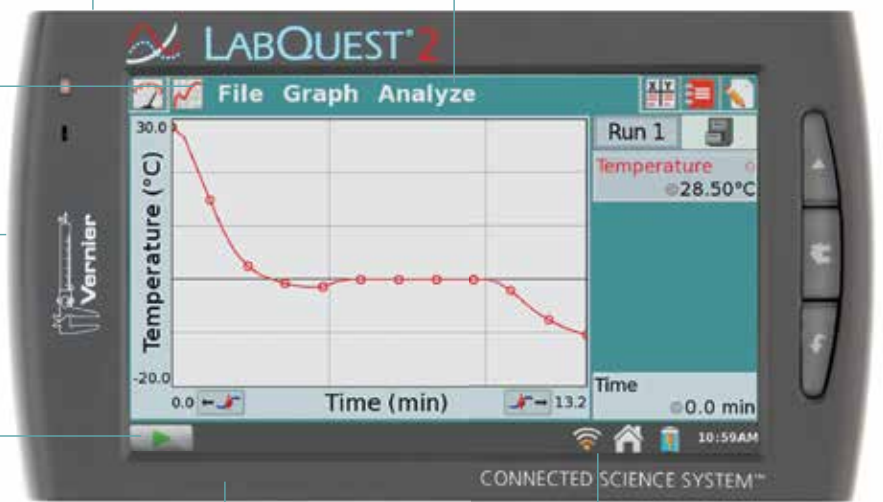
Full sensor support
Compatible with all Vernier sensors

Faster analysis
Quick response to touch, curve fits, and modeling

High-resolution touch screen
- 12.8 cm, 800 x 480 pixel resolution
- Designed for both stylus and touch
- Wide viewing angle for lab groups

Built-in sensors
- GPS
- 3-axis accelerometer
- Ambient temperature
- Light
- Microphone

Fast data collection
100,000 samples per second



High-capacity Rechargeable battery
High capacity, lithium-ion rechargeable battery

Wireless connectivity
- Wi-Fi
- Bluetooth
- Go Wireless sensors

USB port for USB sensors, flash drive, or other USB peripherals.

Two digital sensor ports for use with motion detectors, photogates, drop counters, and more.

Three analog sensor ports for use with 61 compatible sensors, such as temperature, pH, and CO_2 sensors.

Power port for use with AC or recharge LabQuest's built-in battery.

Micro SD/MMC card slot

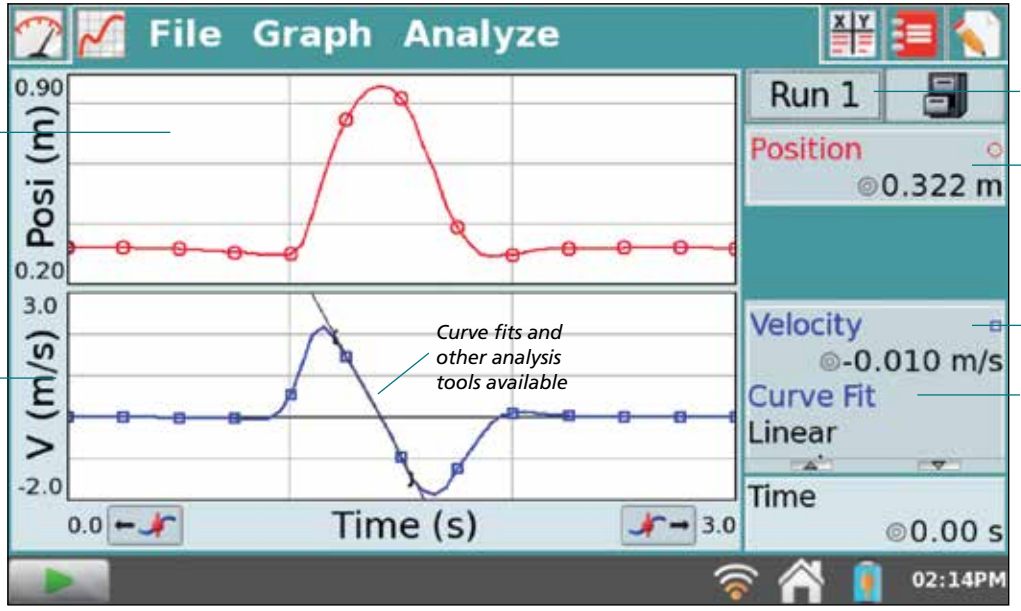
Computer connectivity
Connect your LabQuest to a Windows or Macintosh computer to collect data using Logger *Pro* or Logger Lite.

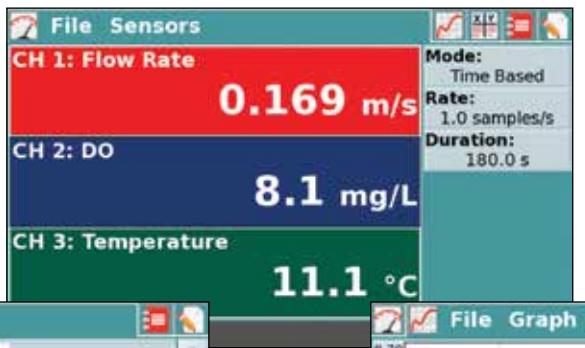
Audio in (left)
Audio out (right)
Connect speakers, microphone, power amplifier, or headphones.

TECHNICAL SPECIFICATIONS

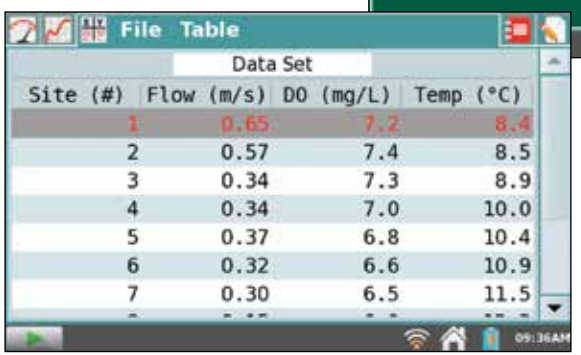
Screen Size: 11.2 cm × 6.7 cm
Screen Resolution: 800 x 480 color display
Weight: 350 g
CPU: 800 MHz application processor
Battery: Lithium-ion rechargeable battery; carries a one-year warranty

Included with LabQuest 2: LabQuest 2 unit, rechargeable battery, USB cable, power adapter, stylus, stylus tether

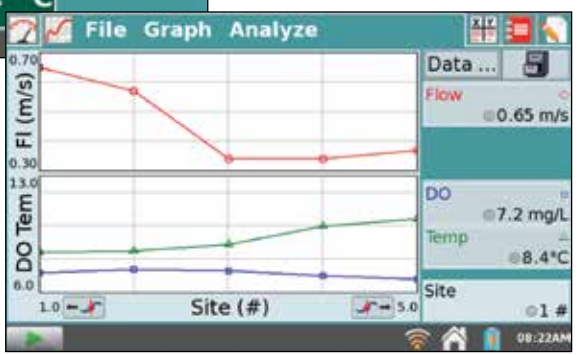




Meter



Data table



Graph

Built-in Software

ANALYSIS FEATURES

- Perform linear and curve fits
- Landscape and portrait views
- Supports built-in sensors—GPS, microphone, accelerometers, relative light sensor, temperature
- Draw a prediction before collecting data
- Display two graphs at once
- Display a tangent line on the graph
- Integral function
- Statistics

BUILT-IN APPLICATIONS

- Stopwatch
- Periodic table
- Scientific calculator
- Audio function generator
- Power amplifier (requires Vernier Power Amplifier)

OTHER GREAT FEATURES

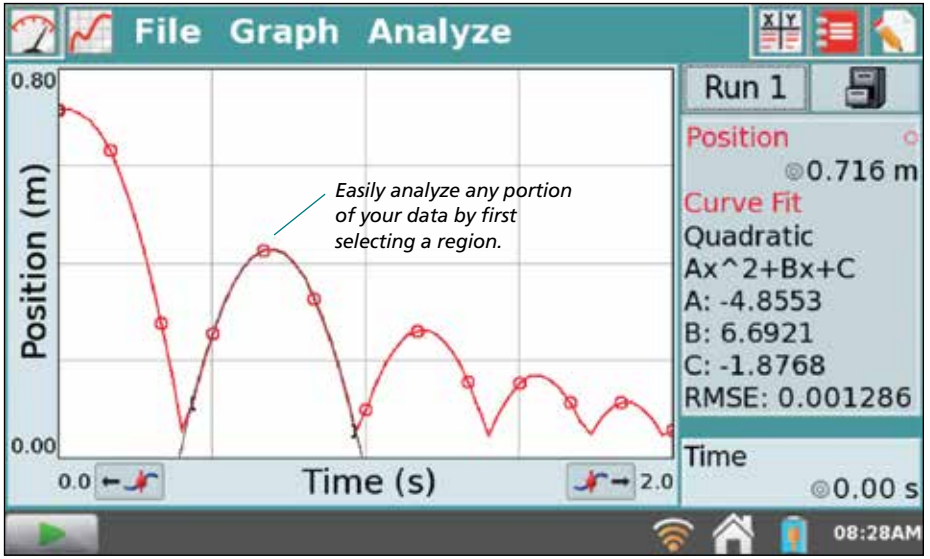
- Stream data wireless (using Wi-Fi) to iPad, Chromebooks, Android, and other mobile devices
- Collect data from Go Wireless sensors
- Export data to Logger *Pro*
- View with our Logger Lite (free download from our website)
- More than 100 preloaded lab instructions from Vernier's popular lab books
- Notes field
- Voice annotation with internal microphone
- Find slopes, fit a line to a portion of your data, and display position data and its derivatives

One-Touch Simplicity

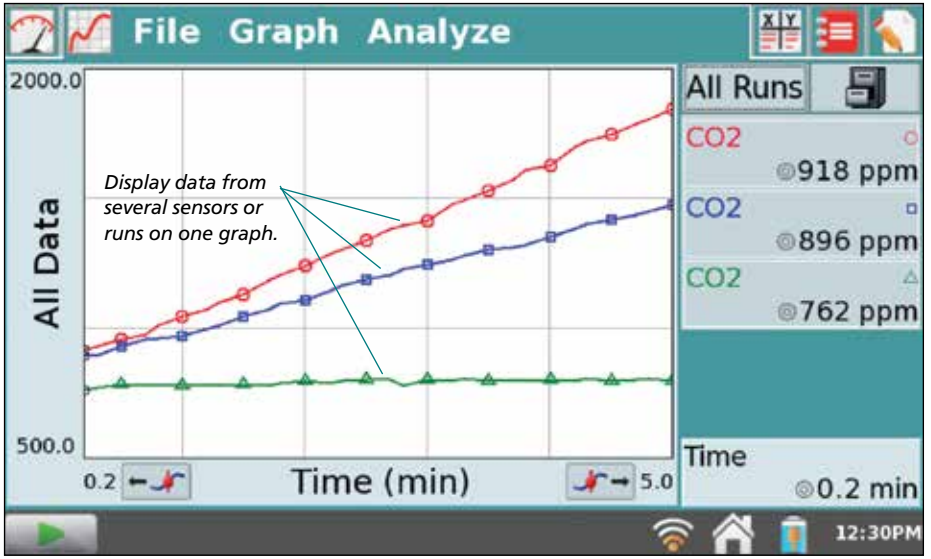
The LabQuest App gives your students real-time graphing capabilities in a handheld device. It's powerful—yet beautifully simple.

Your students can collect data and view them in a **Data Table, Meter,** or **Graph View.**

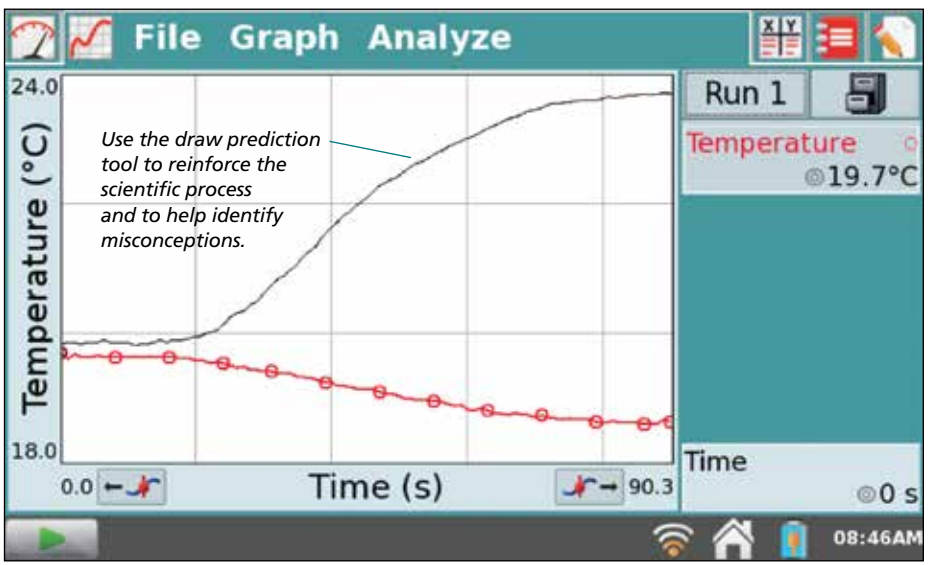
Data analysis at your fingertips



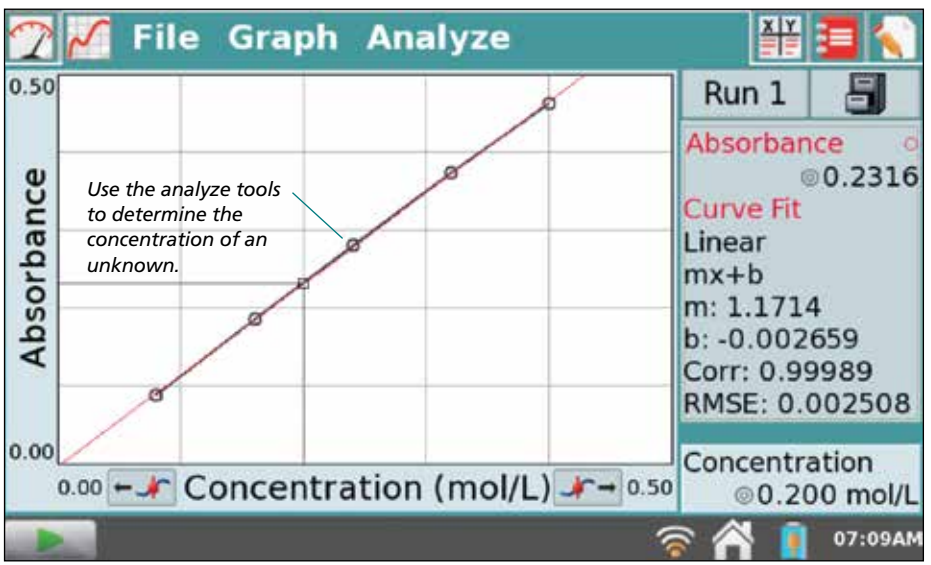
Position vs. time graph of a bouncing ball



Investigating the rate of cellular respiration at different temperatures

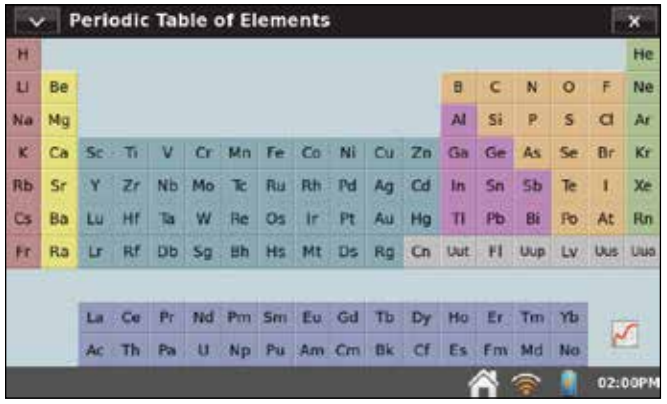


Temperature vs. time graph as an Alka-Seltzer® tablet dissolves in water

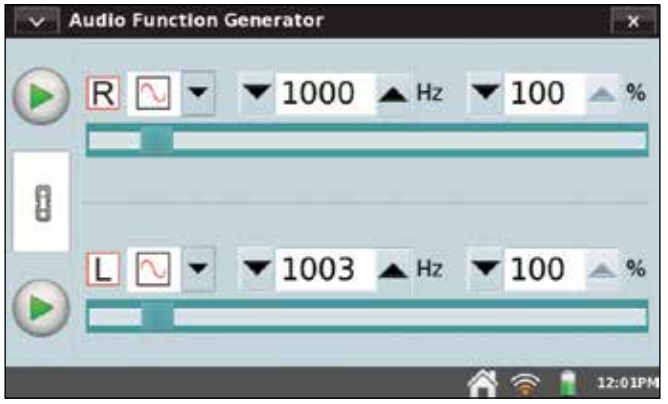


Beer's law analysis of nickel (II) sulfate solution

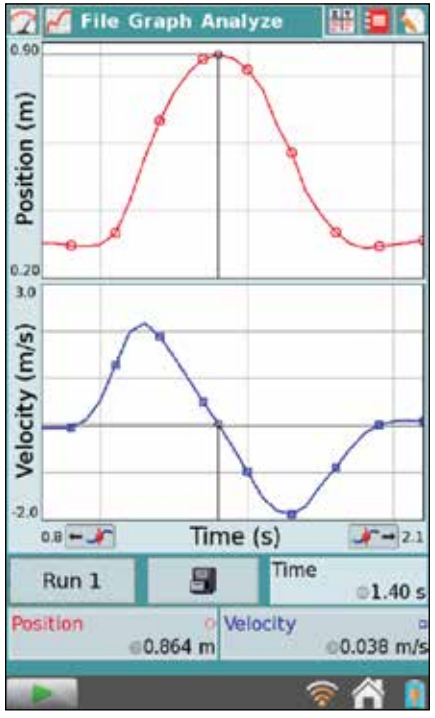
Additional Applications and Features



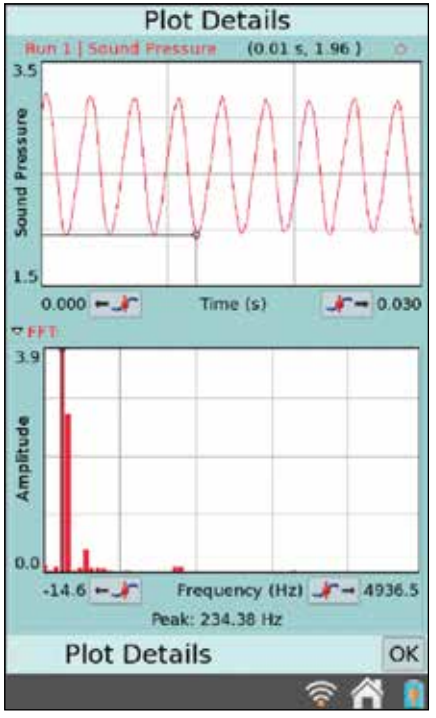
On-board Periodic Table Application



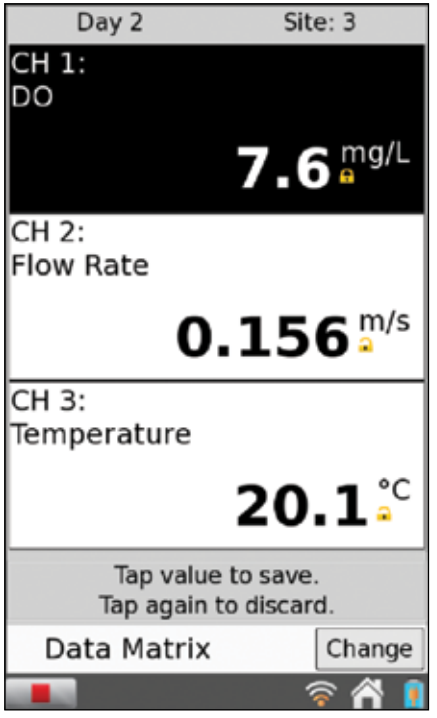
Audio Function Generator



Rotate your LabQuest 2 to view two graphs in portrait view.



Advanced features include FFT analysis.



High-contrast screen setting makes it easier to see your data in bright light.

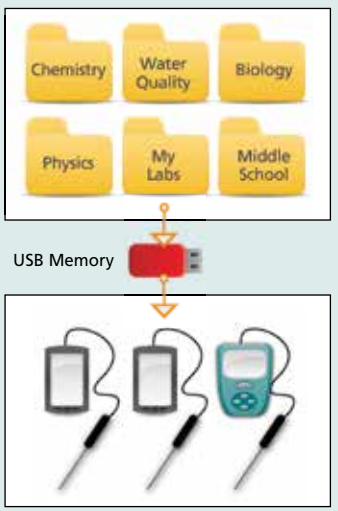
MY LABQUEST LIBRARY

Create, customize, organize, and download labs to LabQuest for the entire class.
www.vernier.com/mylabquest

LAB CREATOR LAB ORGANIZER

Create your own labs with the Lab Creator
Use this **FREE** custom application to create and easily upload your labs to LabQuest.

Customize your LabQuest with the Lab Organizer
More than 400 Vernier experiments from 18 lab books are available to upload to your LabQuest.

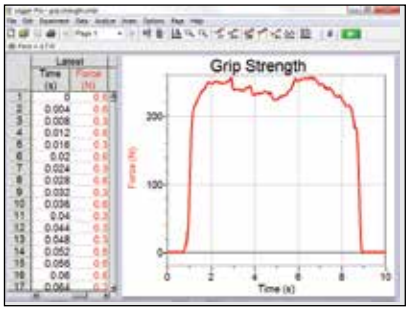


Did you know?

You can have a mixed classroom of LabQuest 2 and original LabQuest units without having to give separate lab instructions for each. We designed the LabQuest 2 to support side-by-side use with the original LabQuest. See page 130.

Easily download your data from LabQuest to a computer for further analysis with Logger *Pro* software

For more information about Logger *Pro*, see pp. 28–31.



Determining grip strength

Screens are from LabQuest 2 (above) and Logger Pro *(right).*

LABQUEST 2 COMPATIBLE SENSORS AND DEVICES

SENSOR	CODE	PRICE
Accelerometers		
3-Axis Accelerometer	3D-BTA	$99
25-g Accelerometer	ACC-BTA	$92
Low-g Accelerometer	LGA-BTA	$89
Anemometer	ANM-BTA	$89
Barometer	BAR-BTA	$71
Blood Pressure Sensor	BPS-BTA	$105
Charge Sensor	CRG-BTA	$75
CO_2 Gas Sensor	CO2-BTA	$249
IMPROVED Colorimeter	COL-BTA	$115
Conductivity Probe	CON-BTA	$95
Constant Current System	CCS-BTA	$59
Current Probes		
Current Probe	DCP-BTA	$39
High Current Sensor	HCS-BTA	$79
Diffraction Apparatus	DAK	$549
Digital Control Unit †	DCU-BTD	$61
Dissolved Oxygen Probes		
Dissolved Oxygen Probe	DO-BTA	$209
Optical DO Probe	ODO-BTA	$389
Drop Counter	VDC-BTD	$99
EKG Sensor	EKG-BTA	$147
Electrode Amplifiers		
Electrode Amplifier	EA-BTA	$40
NEW Go Wireless Electrode Amplifier	GW-EA	$79
NEW Vernier Energy Sensor	VES-BTA	$69
Ethanol Sensor	ETH-BTA	$109
Flow Rate Sensor	FLO-BTA	$129
Force Sensors		
Dual-Range Force Sensor	DFS-BTA	$109
Force Plate	FP-BTA	$245
NEW Vernier Structures & Materials Tester	VSMT	$999
Gas Pressure Sensor	GPS-BTA	$83
Goniometer	GNM-BTA	$159
Hand Dynamometer	HD-BTA	$99

SENSOR	CODE	PRICE
Heart Rate Monitors		
NEW Go Wireless Heart Rate*	GW-HR	$89
Hand-Grip Heart Rate Monitor	HGH-BTA	$119
Instrumentation Amplifier	INA-BTA	$69
Ion-Selective Electrodes		
Ammonium Ion-Selective Electrode	NH4-BTA	$179
Calcium Ion-Selective Electrode	CA-BTA	$179
Chloride Ion-Selective Electrode	CL-BTA	$179
Nitrate Ion-Selective Electrode	NO3-BTA	$179
Potassium Ion-Selective Electrode	K-BTA	$179
Light Sensor	LS-BTA	$55
Magnetic Field Sensor	MG-BTA	$58
Mass (Ohaus Balances)		
Scout Pro 0.01 g (200 g)	OHSP-202	$362
Scout Pro 0.01 g (400 g)	OHSP-402	$486
Scout Pro 0.001 g (120 g)	OHSP-123	$475
Melt Station	MLT-BTA	$469
Microphone	MCA-BTA	$39
Mini GC Plus	GC2-MINI	$1,989
Motion Detectors		
Go!Motion Motion Detector	GO-MOT	$109
Motion Detector	MD-BTD	$79
Motion Encoder System – *see pp. 110–112*		
O_2 Gas Sensor	O2-BTA	$188
ORP Sensor	ORP-BTA	$79
PAR Sensor	PAR-BTA	$189
pH Sensors		
NEW Go Wireless pH*	GW-PH	$99
pH Sensor	PH-BTA	$79
pH Sensor, Tris-Compatible Flat	FPH-BTA	$99
Photogate	VPG-BTD	$45
Polarimeter (Chemical)	CHEM-POL	$499
Power Amplifier	PAMP	$199
Projectile Launcher	VPL	$299

SENSOR	CODE	PRICE
Pyranometer	PYR-BTA	$199
Radiation Monitor	VRM-BTD	$169
Relative Humidity Sensor	RH-BTA	$69
Respiration Monitor Belt *(requires GPS-BTA)*	RMB	$63
Rotary Motion Sensor	RMV-BTD	$169
Salinity Sensor	SAL-BTA	$99
Soil Moisture Sensor	SMS-BTA	$95
Sound Level Meter	SLM-BTA	$165
Spectrometers		
SpectroVis Plus Spectrophotometer	SVIS-PL	$469
Vernier Emissions Spectrometer	VSP-EM	$799
Vernier UV-VIS Spectrophotometer	VSP-UV	$1,999
Ocean Optics Spectrometers		
Vernier Spectrometer	V-SPEC	$1,499
Spirometer	SPR-BTA	$199
Temperature Probes		
Extra-Long Temperature Probe	TPL-BTA	$79
Go!Temp Temperature Probe	GO-TEMP	$39
Go Wireless Temp*	GW-TEMP	$75
Infrared Thermometer	IRT-BTA	$169
Stainless Steel Temperature Probe	TMP-BTA	$29
Surface Temperature Sensor	STS-BTA	$23
Thermocouple	TCA-BTA	$69
Wide-Range Temperature Probe	WRT-BTA	$79
Turbidity Sensor	TRB-BTA	$112
UV Sensors		
UVA Sensor	UVA-BTA	$106
UVB Sensor	UVB-BTA	$107
Voltage Probes		
Differential Voltage Probe	DVP-BTA	$39
Voltage Probe	VP-BTA	$12
30-Volt Voltage Probe	30V-BTA	$49
Watts Up Pro	WU-PRO	$145
Wireless Dynamics Sensor System	WDSS	$249

* Older LabQuest 2 interfaces (Model: LABQUEST2) require the Go Wireless USB Radio (GW-RADIO, $29), sold separately. † Use with computers only.

For more information about sensors, see pp. 140–162.

Did you know?

The original LabQuest and LabQuest 2 can print directly to most HP printers. Simply connect LabQuest to the printer with a standard USB cable. You can also use Wi-Fi connectivity to connect to HP printers on your school network or directly to Wi-Fi enabled HP printers.

Built-in Stopwatch

On-Board Scientific Calculator

a. LabQuest Viewer®, ORDER CODE **LQ-VIEW, $79**
LabQuest Viewer (electronic download*), **LQ-VIEW-E, $79**

Teach students how to use LabQuest by projecting your LabQuest screen via Wi-Fi. Use built-in Wi-Fi on LabQuest 2 to remotely monitor student progress by viewing student LabQuests. Compatible with both Mac and PC.

Computer software includes a site license for every teacher's computer in your school or college department.

LabQuest Viewer is also available for iPad®. See page 32.

* Provide an email address to which we will send download information.

---

b. LabQuest 2 Lab Armor, ORDER CODE **LQ2-ARMOR, $15**

Add extra protection from spills and falls with Lab Armor for LabQuest 2. Molded rubber material helps prevent spills from getting into open ports.

---

c. LabQuest Lanyard, ORDER CODE **LQ-LAN, $5**

This lanyard connects to the back of your LabQuest, so you don't have to worry about students dropping their interface during field studies.

---

d. LabQuest 2 Charging Station, ORDER CODE **LQ2-CRG, $109**

Want a way to charge and store your LabQuest 2 units? The LabQuest 2 Charging Station has four charging slots with LEDs to indicate the charging status. Note: If you have original LabQuests, see page 164.

---

e. LabQuest Battery Boost 2, ORDER CODE **LQ-BOOST2, $109**

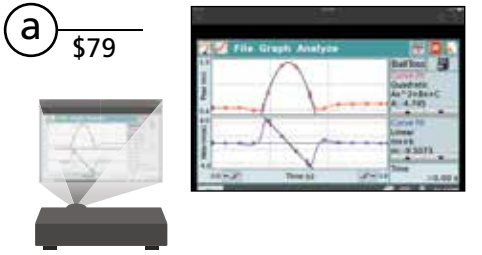
The Battery Boost 2 is a rechargeable external battery for your original LabQuest or LabQuest 2. With the Battery Boost 2, data can be collected for extended periods in the field where AC power is not available.

---

f. LabQuest 2 Stand, ORDER CODE **LQ2-STN, $5**

Use this stand to set LabQuest 2 at an angle for easier viewing. The stand can also reduce the possibility of damage due to spills by raising LabQuest 2 off of the lab bench.

a $79



b $15

c $5

d $109

e $109

f $5

LabQuest MINI

$149
ORDER CODE
LQ-MINI

Affordable. Powerful. Easy to Use.

LabQuest Mini brings the power of Vernier's award-winning LabQuest technology to teachers who don't need the versatility of a standalone device. The perfect solution for educators collecting data with a computer, LabQuest Mini interfaces with Logger Lite and Logger *Pro* software for unparalleled power, analysis, and curricular support.

Key features:

- 100 kHz maximum sampling rate gives you the unrivaled power of LabQuest.
- Five sensor ports give you the flexibility to choose from over 72 compatible sensors.

"Excellent product that will serve many classroom environments well."
– Tech & Learning

FIVE TOTAL SENSOR PORTS

Three Analog Sensor Ports
For use with 61 compatible sensors, such as temperature, pH, and force.

Two Digital Sensor Ports
For use with digital sensors, such as motion detectors, photogates, chemical polarimeters, diffraction apparatus, and drop counters.

COLLECTING DATA EXCLUSIVELY ON COMPUTERS?

LabQuest Mini may be perfect for you!

- You can download our FREE Logger Lite software from our website to get your students quickly collecting and analyzing data.
- Looking for more advanced features than Logger Lite provides? Our award-winning Logger *Pro* 3 software provides advanced analytical features, including video analysis. See pp. 28–31 for additional details.
- Use with over 20 Vernier lab books covering core topics in Biology, Chemistry, Earth Science, Engineering, Environmental Science, Physical Science, Physics, Physiology, Renewable Energy, and Water Quality.

TECHNICAL SPECIFICATIONS

Computer Connection:
USB 2.0 Full Speed

Software Requirements:
Logger *Pro* 3.8.2 or newer
or Logger Lite 1.5 or newer

Analog Inputs: 3

Digital Inputs: 2

Sampling Rate:
100,000 samples per second

LABQUEST MINI COMPATIBLE SENSORS* AND DEVICES

SENSOR	CODE	PRICE
Accelerometers		
3-Axis Accelerometer	3D-BTA	$99
25-g Accelerometer	ACC-BTA	$92
Low-g Accelerometer	LGA-BTA	$89
Anemometer	ANM-BTA	$89
Barometer	BAR-BTA	$71
Blood Pressure Sensor	BPS-BTA	$105
Charge Sensor	CRG-BTA	$75
CO_2 Gas Sensor	CO2-BTA	$249
IMPROVED Colorimeter	COL-BTA	$115
Conductivity Probe	CON-BTA	$95
Constant Current System	CCS-BTA	$59
Current Probes		
Current Probe	DCP-BTA	$39
High Current Sensor	HCS-BTA	$79
Diffraction Apparatus	DAK	$549
Digital Control Unit †	DCU-BTD	$61
Dissolved Oxygen Probes		
Dissolved Oxygen Probes	DO-BTA	$209
Optical DO Probe	ODO-BTA	$389
Drop Counter †	VDC-BTD	$99
EKG Sensor	EKG-BTA	$147
Electrode Amplifier	EA-BTA	$40
NEW Vernier Energy Sensor	VES-BTA	$69
Ethanol Sensor †	ETH-BTA	$109
Flow Rate Sensor	FLO-BTA	$129
Force Sensors		
Dual-Range Force Sensor	DFS-BTA	$109

SENSOR	CODE	PRICE
Force Sensors (*continued*)		
Force Plate	FP-BTA	$245
NEW Vernier Structures & Materials Tester †	VSMT	$999
Gas Pressure Sensor	GPS-BTA	$83
Goniometer	GNM-BTA	$159
Hand Dynamometer	HD-BTA	$99
Hand-Grip Heart Rate Monitor	HGH-BTA	$119
Instrumentation Amplifier	INA-BTA	$69
Ion-Selective Electrodes		
Ammonium Ion-Selective Electrode	NH4-BTA	$179
Calcium Ion-Selective Electrode	CA-BTA	$179
Chloride Ion-Selective Electrode	CL-BTA	$179
Nitrate Ion-Selective Electrode	NO3-BTA	$179
Potassium Ion-Selective Electrode	K-BTA	$179
Light Sensor	LS-BTA	$55
Magnetic Field Sensor	MG-BTA	$58
Melt Station †	MLT-BTA	$469
Microphone	MCA-BTA	$39
Motion Detector	MD-BTD	$79
Motion Encoder System † – *see pp.110–112*		
O_2 Gas Sensor	O2-BTA	$188
ORP Sensor	ORP-BTA	$79
PAR Sensor	PAR-BTA	$189
pH Sensors		
pH Sensor	PH-BTA	$79
pH Sensor, Tris-Compatible Flat	FPH-BTA	$99
Photogate †	VPG-BTD	$45

SENSOR	CODE	PRICE
Polarimeter (Chemical) †	CHEM-POL	$499
Power Amplifier	PAMP	$199
Projectile Launcher †	VPL	$299
Pyranometer	PYR-BTA	$199
Radiation Monitor †	VRM-BTD	$169
Relative Humidity Sensor	RH-BTA	$69
Respiration Monitor Belt (requires GPS-BTA)	RMB	$63
Rotary Motion Sensor †	RMV-BTD	$169
Salinity Sensor	SAL-BTA	$99
Soil Moisture Sensor	SMS-BTA	$95
Sound Level Meter	SLM-BTA	$165
Spirometer	SPR-BTA	$199
Temperature Probes		
Extra-Long Temperature Probe	TPL-BTA	$79
Infrared Thermometer	IRT-BTA	$169
Stainless Steel Temperature Probe	TMP-BTA	$29
Surface Temperature Sensor	STS-BTA	$23
Thermocouple	TCA-BTA	$69
Wide-Range Temperature Probe	WRT-BTA	$79
Turbidity Sensor	TRB-BTA	$112
UV Sensors		
UVA Sensor	UVA-BTA	$106
UVB Sensor	UVB-BTA	$107
Voltage Probes		
Differential Voltage Probe	DVP-BTA	$39
Voltage Probe	VP-BTA	$12
30-Volt Voltage Probe	30V-BTA	$49

* Sensors connected to a LabQuest Mini can be used in combination with our 12 supported USB and Bluetooth sensors including Go!Temp, Go!Motion, Vernier GPS, and more. † Not supported with Logger Lite software

Go!Link®

USB Interface

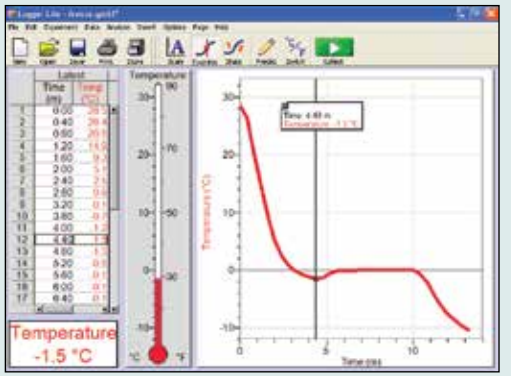
A quick and affordable way to get started with data-collection technology.

- Single-channel interface connects any one of 56 Vernier sensors to your Chromebook™ or computer's USB port. (See list of sensors below. Chromebook compatibility available late spring.)
- Dozens of experiments from our popular lab books can be conducted using Go!Link.

Go!Link, ORDER CODE **GO-LINK, $61**
Free software available: Graphical Analysis™ app for Chrome or Logger Lite computer software

Teacher Pack of 8 Go!Links, ORDER CODE **GL-TP, $473**

ONLY $61



FREE LOGGER LITE SOFTWARE

Real-Time Graphing

Go!Link, Go!Temp, and Go!Motion include Logger Lite software with purchase.

Rather than tell students that water changes state at 0°C, let them see it for themselves! You can also investigate magnetic fields, gravity, and force with hands-on exploration and activities to help reinforce scientific concepts.

- Collect data using one or more sensors
- Calculate statistics
- Annotate graphs
- Print graphs
- Write reports
- Easily export data and graphs

Logger *Pro* 3 software, ORDER CODE **LP, $249**
Want to import experiment movies and synchronize data with video? For more advanced software features, you'll want Logger *Pro*. Buy just one copy—site license for **ALL school and students' personal computers** is included! See pp. 28–31.

GO!LINK COMPATIBLE SENSORS

SENSOR	CODE	PRICE	SENSOR	CODE	PRICE	SENSOR	CODE	PRICE
Accelerometers			Goniometer	GNM-BTA	$159	Relative Humidity Sensor	RH-BTA	$69
25-g Accelerometer	ACC-BTA	$92	Hand Dynamometer	HD-BTA	$99	Respiration Monitor Belt *(Requires GPS-BTA)*	RMB	$63
Low-g Accelerometer	LGA-BTA	$89	Hand-Grip Heart Rate Monitor	HGH-BTA	$119	Salinity Sensor	SAL-BTA	$99
Anemometer	ANM-BTA	$89	Instrumentation Amplifier	INA-BTA	$69	Soil Moisture Sensor	SMS-BTA	$95
Barometer	BAR-BTA	$71	Ion-Selective Electrodes			Sound Level Meter	SLM-BTA	$165
Blood Pressure Sensor	BPS-BTA	$105	Ammonium Ion-Selective Electrode	NH4-BTA	$179	Spirometer	SPR-BTA	$199
Charge Sensor	CRG-BTA	$75	Calcium Ion-Selective Electrode	CA-BTA	$179	Temperature Probes		
CO_2 Gas Sensor	CO2-BTA	$249	Chloride Ion-Selective Electrode	CL-BTA	$179	Extra-Long Temperature Probe	TPL-BTA	$79
Colorimeter	COL-BTA	$115	Nitrate Ion-Selective Electrode	NO3-BTA	$179	Infrared Thermometer	IRT-BTA	$169
Conductivity Probe	CON-BTA	$95	Potassium Ion-Selective Electrode	K-BTA	$179	Stainless Steel Temperature Probe	TMP-BTA	$29
Constant Current System	CCS-BTA	$59	Light Sensor	LS-BTA	$55	Surface Temperature Sensor	STS-BTA	$23
Current Probes			Magnetic Field Sensor	MG-BTA	$58	Thermocouple	TCA-BTA	$69
Current Probe	DCP-BTA	$39	Melt Station	MLT-BTA	$469	Wide-Range Temperature Probe	WRT-BTA	$79
High Current Sensor	HCS-BTA	$79	O_2 Gas Sensor	O2-BTA	$188	Turbidity Sensor	TRB-BTA	$112
Dissolved Oxygen Probe	DO-BTA	$209	ORP Sensor	ORP-BTA	$79	UV Sensors		
Dual-Range Force Sensor	DFS-BTA	$109	PAR Sensor	PAR-BTA	$189	UVA Sensor	UVA-BTA	$106
EKG Sensor	EKG-BTA	$147	pH Sensors			UVB Sensor	UVB-BTA	$107
Electrode Amplifier	EA-BTA	$40	pH Sensor	PH-BTA	$79	Voltage Probes		
Flow Rate Sensor	FLO-BTA	$129	pH Sensor, Tris-Compatible Flat	FPH-BTA	$99	Differential Voltage Probe	DVP-BTA	$39
Force Plate	FP-BTA	$245	Power Amplifier	PAMP	$199	Voltage Probe	VP-BTA	$12
Gas Pressure Sensor	GPS-BTA	$83	Pyranometer	PYR-BTA	$199	30-Volt Voltage Probe	30V-BTA	$49

For a list of sensors compatible with Graphical Analysis for Chrome, visit **www.vernier.com/ga-chrome**

Go!Temp®

USB Temperature Probe

Collect temperature data for only $39! Go!Temp plugs directly into your Chromebook or computer's USB port without the need for an additional interface. This rugged, stainless-steel temperature probe engages your students in hands-on science as they explore temperature investigations. Compatible with Chrome™ OS, Mac OS® X, and Windows®.

Tech Specs:
Range: –20 to 115°C
Max temp without damage: 150°C
Compatible with: Chrome OS, Mac OS X, and Windows

ONLY $39

Go!Temp, ORDER CODE **GO-TEMP, $39**
Free software available: Graphical Analysis™ app for Chrome or Logger Lite computer software

Teacher Pack of 8 Go!Temps, ORDER CODE **GT-TP, $299**

Go!Motion®

USB Motion Detector

- Teach important concepts in physics and physical science, such as position, velocity, and acceleration.
- Study the motion of a ball tossed in the air or a cart on a ramp.
- Engage your students with hands-on activities.

Go!Motion
ORDER CODE **GO-MOT, $109**
Free software available: Graphical Analysis app for Chrome or Logger Lite computer software

Teacher Pack of 8 Go!Motions
ORDER CODE **GO-MOT-TP, $846**

Head pivots to align with your experiment
Sensitivity switch optimizes data collection to suit your apparatus
Connects directly to a USB port
(USB cable included)
GoMotion
Vernier

ONLY $109

MORE ONLINE – Go!Motion is compatible with Chrome OS, Mac OS X and Windows. Go!Motion can also be used with Logger *Pro* computer software. Go!Motion can also be used with LabPro, LabQuest 2, LabQuest, LabQuest Mini, CBL 2, TI-Nspire™ Lab Cradle, or a TI graphing calculator. Visit our website for more information at **www.vernier.com/go-mot**

GO! QUICK-START PACKAGE

ORDER CODE **GO-QSP, $108**

Includes:

- Go! Link interface
- Our award-winning Go!Temp USB temperature probe
- A TI Light Probe for measuring light intensity
- Available free software: Graphical Analysis app for Chrome and Logger Lite computer software

ONLY $108

Logger *Pro* 3

Real-Time Graphing and Powerful Analytical Tools

Logger *Pro* is our flagship data-collection and analysis application for Windows and Mac. With the complete suite of data-collection and analysis tools, Logger *Pro* is suitable for all students, beginning to advanced.

- Logger *Pro* is the most popular data-collection program in science education. Why? Teachers tell us that students find our software to be very easy and intuitive to use.
- One program does it all—for only $249—for all of your computers AND your students' personal computers.
- Think of Logger *Pro* as the digital data hub of your classroom and lab. It can gather data from a variety of sources, including LabQuest 2, original LabQuest, LabQuest Mini, LabPro, Go! devices, Ohaus balances, compatible TI graphing calculators, spectrometers, GPS units, manual entry, and more. Logger *Pro* also shares data wirelessly with Chromebook™, iPad®, Android™ tablets, and other mobile devices.

Don't need all this power or working with younger students? Logger Lite, a streamlined subset of Logger *Pro*, is available at no charge for use with LabQuest 2, LabQuest Mini, Go!Temp, Go!Link, and Go!Motion.

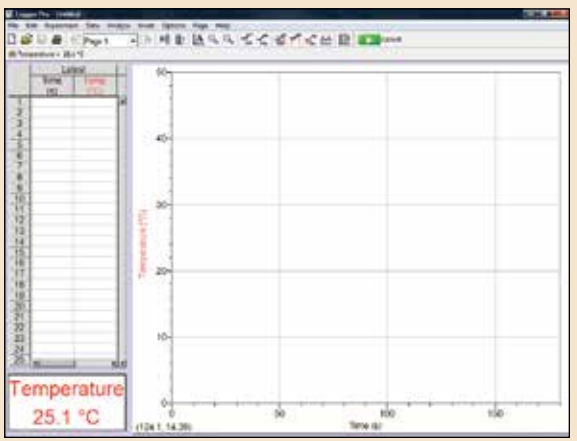
AWARD-WINNING

LOGGER *PRO* 3 GREAT VALUE!

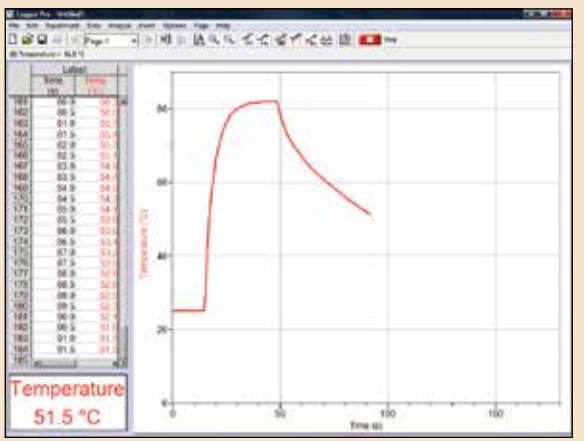
- Logger *Pro* 3 includes a site license for your entire school or college department.
- Site license includes home computers of faculty.
- Site license includes home computers of students—let them take it home!
- No need to count computers to satisfy licensing.
- Logger *Pro* 3 updates are free.
- Logger *Pro* 3 Data Sharing
  - Supports Graphical Analysis™ for iOS, Android, Chrome™ and Vernier Data Share web app for other mobile devices and computers.
  - Streams data to multiple devices, allowing for 1:1 learning in lab groups and classrooms.

Logger *Pro* 3 (with manual and CD), ORDER CODE **LP, $249**
Logger *Pro* 3 (electronic download*), ORDER CODE **LP-E, $249**

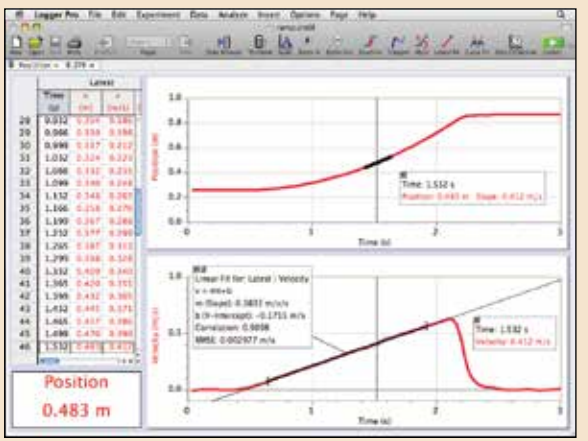
* Provide an email address to which we will send download information.



Start Logger Pro *with a temperature sensor connected. A graph, data table, and meter are all ready to go. Click Collect, and you're taking data.*



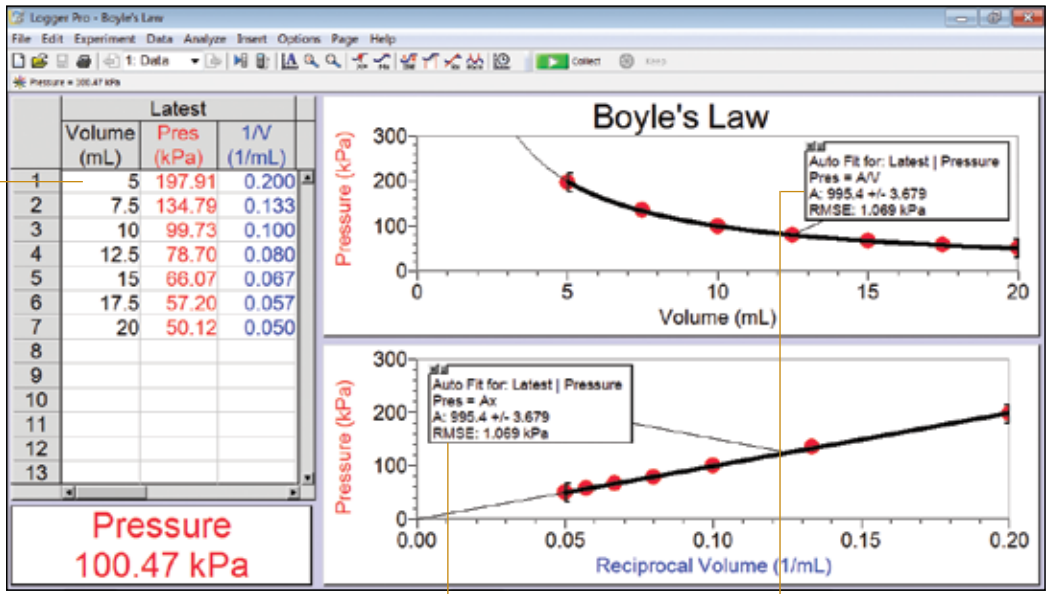
After you click Collect, Logger Pro *draws the graph in real time, and the data table and digital meter update continuously.*



Draw tangent lines to find local slopes and fit lines to selected regions—the analysis tools you need in Logger Pro *are at your fingertips.*

Basic Features

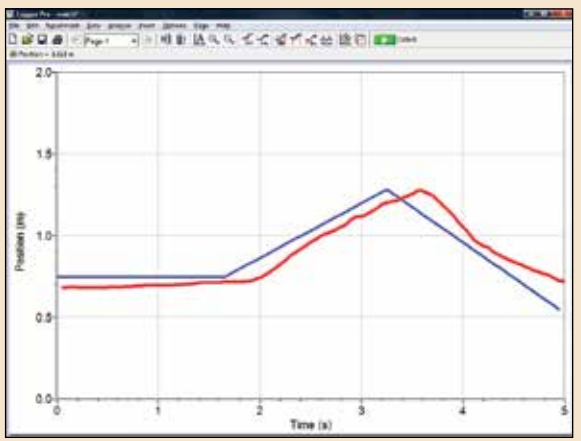
- Ease of use: connect a sensor, launch Logger *Pro,* and click Collect. Auto-ID sensors make setup effortless.
- Collect live data from more than 80 different sensors and devices.
- Draw predictions on a graph before collecting data.
- Use a variety of data-collection modes as needed for your experiment: time-based data, selected events, events with typed-in entries, photogate, radiation counting, and more.
- Manually enter data for graphing and analysis. All of the functions of Vernier's popular Graphical Analysis desktop application are available in Logger *Pro*.
- Import data from LabQuest and calculators.
- Lay out graphs, tables, and text as needed across multiple pages to describe your experiment.
- Read values and slope from graphs using examine and tangent line tools.
- Print graphs and data tables.



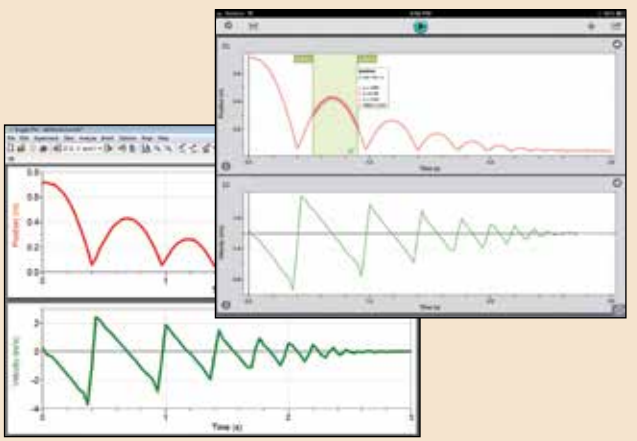
See data presented in many ways: tables, graphs, curve fits, and more.

Replot data to show new relationships.

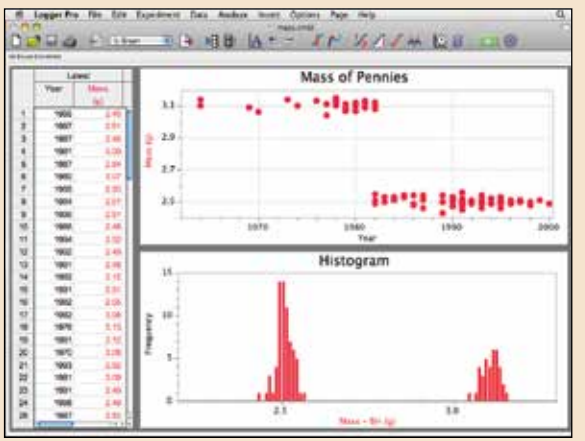
Curve fits show uncertainties in fit parameters. Choose from a library of built-in functions or enter your own.



Logger Pro *automatically creates target graphs for graph-matching exercises.*

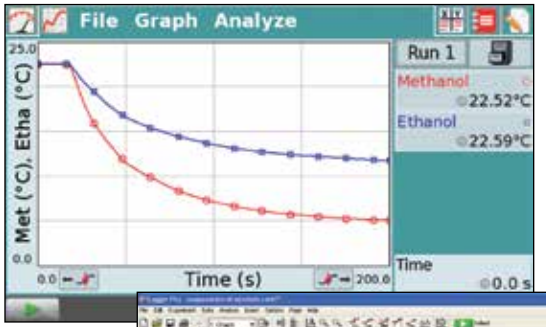


Share Logger Pro *data with Graphical Analysis app.*

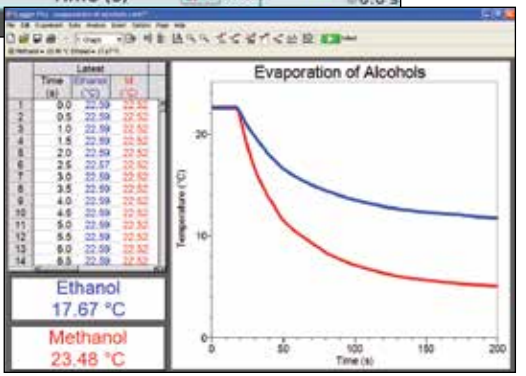


Logger Pro *includes all the premier analysis tools of Graphical Analysis for Windows and Mac. Use directly-captured sensor data, as well as imported and manually entered data.*

Easily download your data from LabQuest App to a computer for further analysis with Logger *Pro* software.



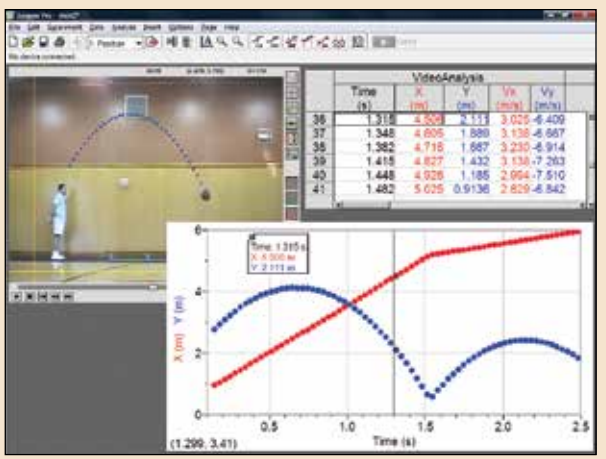
LabQuest App



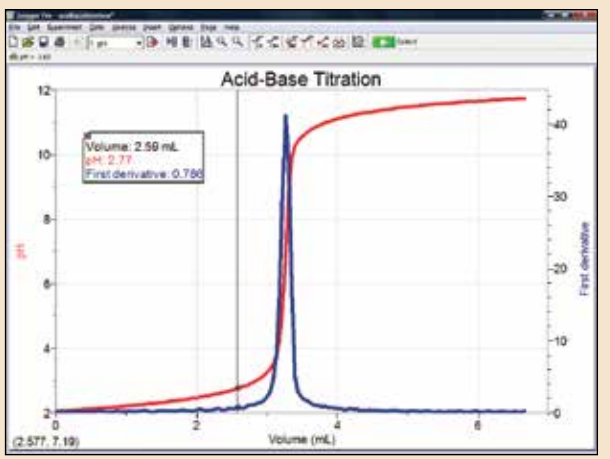
Logger Pro

Advanced Features

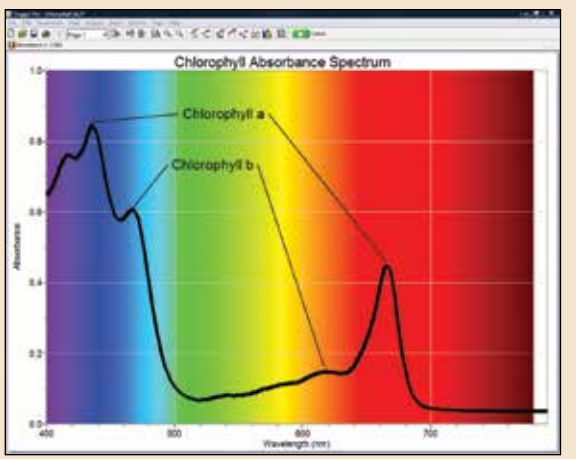
- Graph data in a variety of ways, including XY graphs, log graphs, double-Y graphs, strip charts, and FFT graphs.
- Model data with user-adjustable functions.
- Extract data from movies using frame-by-frame video analysis.
- Capture video from DV cameras and web cameras or import compatible movie files.
- Sync movie playback with sensor data.
- Analyze images of gel electrophoresis.
- Calculated columns allow you to graph new quantities, such as kinetic energy.
- Enhance graphs with date and time stamps.
- Use with Vernier and Ocean Optics™ spectrometers.
- Geolocate and map sensor data with GPS support.
- Perform GC peak analysis.
- Meet IB course goals with manual configuration mode.



Analyze videos to study the motion of individual or multiple objects. This feature alone is worth the price of Logger Pro*!*



Create double-Y graphs to tell complex stories with simplicity.



Collect absorbance data from the SpectroVis Plus, Vernier UV-VIS Spectrophotometer, or Ocean Optics Spectrometers.

LOGGER *PRO* IS COMPATIBLE WITH

Vernier LabQuest 2 and Original LabQuest – Collect live data from LabQuest, retrieve existing data, or open saved files on LabQuest. Compatible with 84 different sensors.

Vernier LabQuest Mini – Connect a LabQuest Mini and use 72 different sensors.

Vernier LabPro – Connect a LabPro to collect data with 72 different sensors.

Go!Temp, Go!Link, and Go!Motion – Connect any of our Go! sensors and get advanced analysis tools in Logger *Pro*. (excludes Go Wireless sensors)

Wireless Dynamics Sensor System – See real-time graphing of acceleration, force, and altitude data via wireless Bluetooth® connection.

Spectrometers – Collect data directly from Vernier and Ocean Optics spectrometers.

Graphical Analysis for iPad, iPhone, and iPod touch – View and analyze data streamed from Logger *Pro* to multiple tablets and auto-save data for later work.

Digital Bioimaging System/ProScope HR – Capture images and study DNA with Logger *Pro*'s gel analysis feature.

Vernier Mini GC Plus – Collect and analyze gas chromatography data with peak analysis features.

TI Graphing Calculators – Use a TI Connectivity Cable to import data into Logger *Pro* from supported TI graphing calculators.

Vernier Video Physics – Capture a video on iPad or iPhone, begin analysis there, and then open the experiment in Logger *Pro* for further analysis.

Video Clips – Capture video clips and synchronize with sensor data or perform video analysis.

Manual Entry – Enter data manually, do further analysis, or write lab reports.

Chromebook – View and analyze Logger *Pro* data in Vernier Graphical Analysis for Chrome, available in the Chrome Web Store.

Teach Graphing and Analysis Skills with Logger *Pro*

High School

- Calculated columns allow graphing of derived data; for example, plot the square of the pendulum length for one axis
- Modeling feature lets students superimpose mathematical functions on their data

Middle School

- Easy unit switching helps teach measurement units
- Time-of-day graphs for weather or other long-term studies

College and University

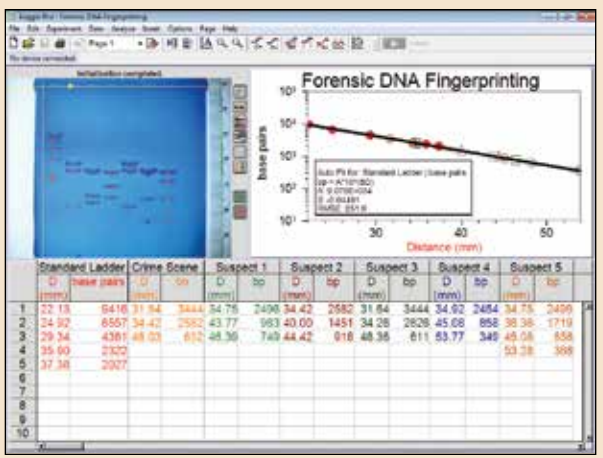
- Includes advanced graphing features, such as log graphs and semi-log graphs
- Custom curve fits allow sophisticated models
- Compatible with advanced Ocean Optics spectrometers

Logger *Pro* 3 (with manual and CD), ORDER CODE **LP, $249**

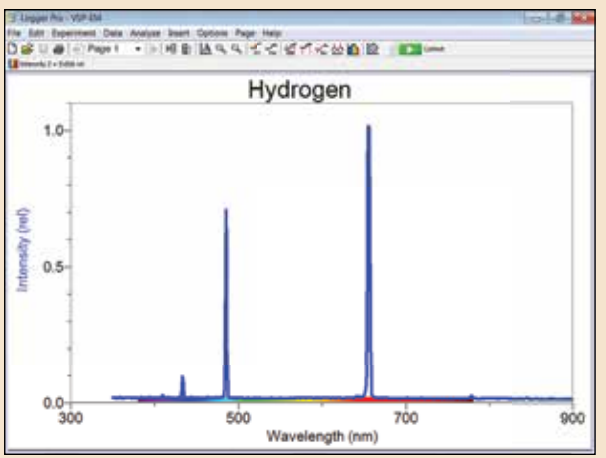
Logger *Pro* 3 (electronic download), ORDER CODE **LP-E, $249**

Logger *Pro* Student 5-Pack, ORDER CODE **LP-ST5, $10**

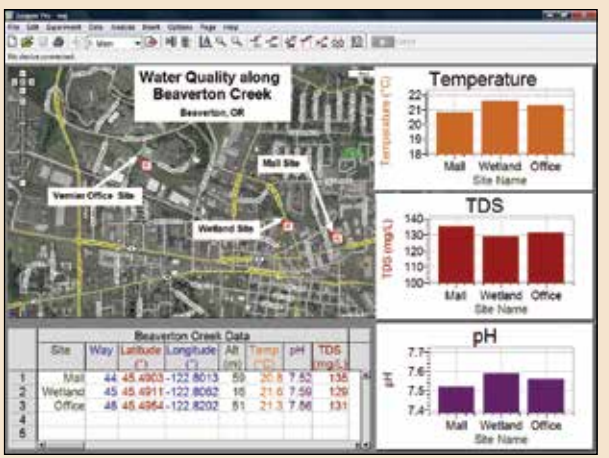
See **www.vernier.com/loggerpro** for upgrade and system compatibility information



Use our Blue Digital Bioimaging System, along with Logger Pro, *to analyze gel electrophoresis data.*



Use the Vernier Emissions Spectrometer to study emission lines from discharge lamps.



Export water quality data to Google Maps™ and incorporate the result into a Logger Pro *page.*

LabQuest Viewer® for iPad

LabQuest Viewer for iPad app allows you to wirelessly view and control LabQuest from your iPad. When used with a projector, you can display any LabQuest screen for the entire class to see. Share the instructor LabQuest screen for demos or share students' LabQuests for class presentations.

Use LabQuest Viewer for iPad in the classroom to

- View and control a LabQuest unit from an iPad, project its screen, or do a class demo
- Control the projected LabQuest directly from the LabQuest or iPad
- Monitor student progress by wirelessly connecting to any LabQuest on your network
- Create screenshots of a LabQuest screen that you can paste into lab instructions and other documents

Requires iOS 8 or newer.

For more info, visit **www.vernier.com/lq-view-ipad**

LabQuest Viewer for iPad is sold only through the App Store. It is a separate purchase from the LabQuest Viewer computer software.

View and control any LabQuest on your network directly from your iPad.

Download on the App Store

iPad, iPhone, and iPod touch are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc.

Video Physics™

Perform Automated Object Tracking on iPad, iPhone, and iPod touch

Video Physics is perfect for physics students and instructors to perform on-the-go analysis of motion. Measure the velocity of a swing, a roller-coaster, or a basketball free-throw shot.

Use Video Physics for iPad in the classroom to

- Capture a new video using the built-in camera, choose a video from your Photos collection, or use one of our sample videos
- Track an object automatically or manually add points to the video frame
- Set the scale of the video using an object of known size
- Optionally set coordinate system location and rotation
- View graphs of trajectory and x/y position and velocity
- Export video with points
- Email the video and data for further analysis in Vernier's Logger *Pro* software for Mac OS X and Windows
- Open data files directly in Vernier's Graphical Analysis app

For more information, visit **www.vernier.com/videophysics**

Video analysis of an accelerating Segway®

Download on the App Store

APP of the week

AWARDS of EXCELLENCE winner!

BEST EDUCATIONAL SOFTWARE AWARD
Winner of 19TH ANNUAL
BESSIE AWARDS

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2012 SIIA CODiE FINALIST

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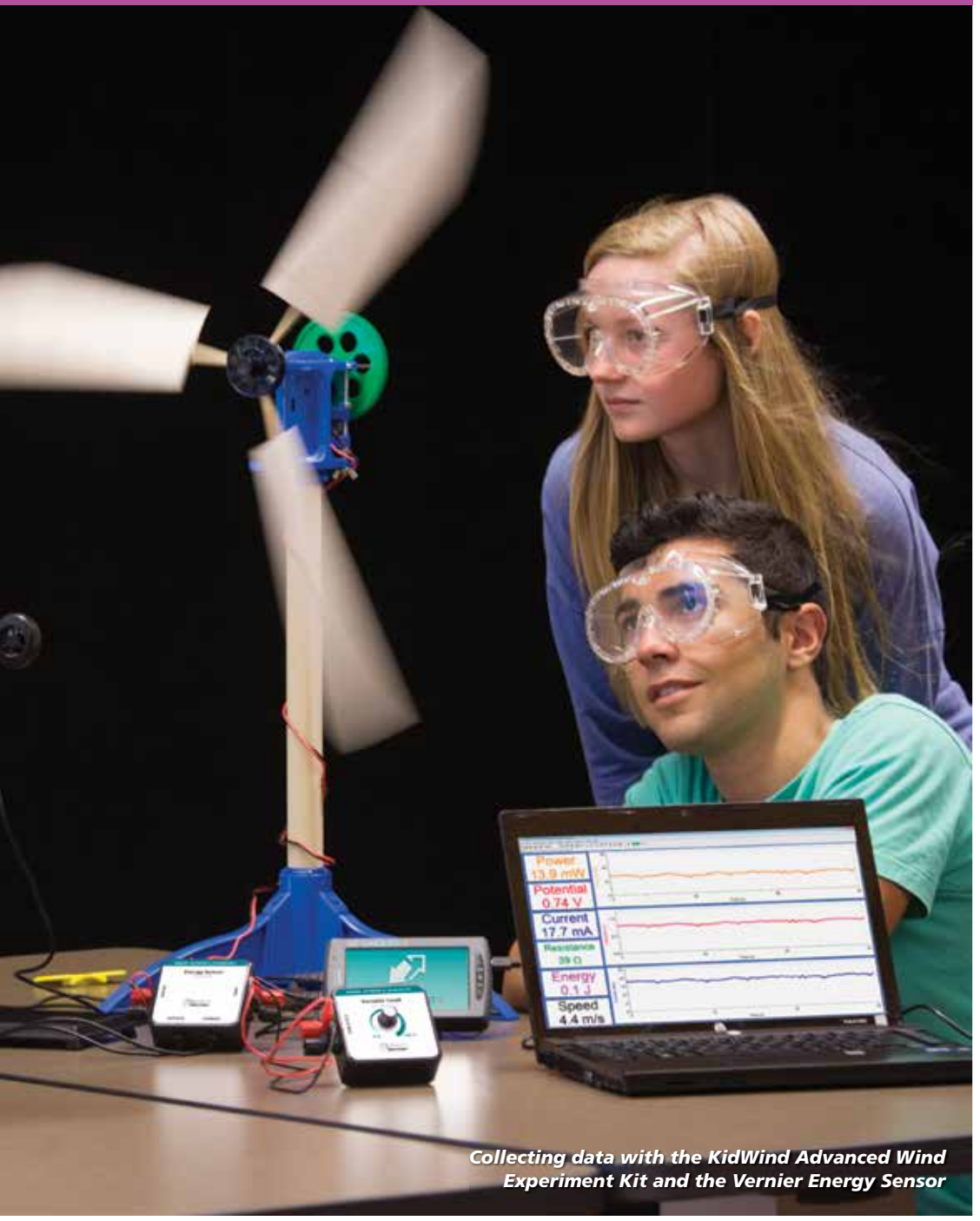
AWARDS 2015
FINALIST



Collecting data with the KidWind Advanced Wind Experiment Kit and the Vernier Energy Sensor

STEM

Experiments Written with Alignment to NGSS

Renewable Energy with Vernier lab book **80**
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Elementary Education

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Vernier Structures & Materials Tester **71**

Engineering Projects and Programming

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Engineering Projects with NI LabVIEW and Vernier lab book **76**
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STEM Curriculum

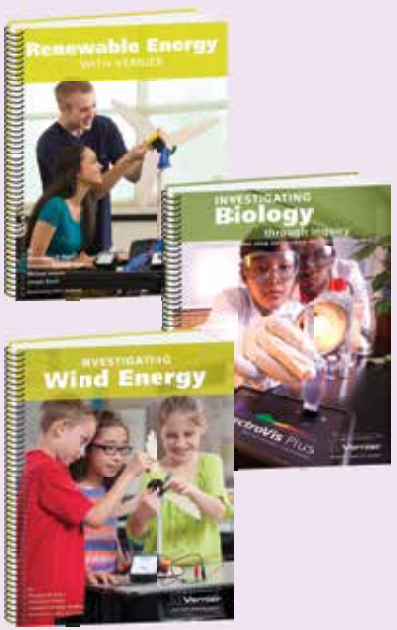
Project Lead the Way **74**

Science

Vernier technology is used in more than 135 countries around the world in biology, biotechnology, chemistry, Earth science, environmental science, physical science, physics, and water quality courses. From elementary schools to graduate studies, you can rely on Vernier technology for hands-on learning when science is the key focus of your STEM program.

Using Vernier technology, students

- Ask questions and define problems to be investigated
- Plan and carry out investigations
- Decide what data are to be gathered and how much data are needed to produce reliable results
- Analyze and interpret data

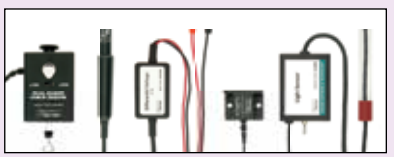


Technology

All Vernier technology—from sensors used in hands-on experiments to technology to test design solutions—supports a robust, engaging STEM education.

"Vernier hardware and software are essential tools that K-12 educators need to engage students in STEM learning that is relevant and inquiry-based using state-of-the-art technology. In addition, teachers who use Vernier technology receive the best user support available. I believe Vernier technology is a key component to any solid STEM curriculum."

– *William Becker, Ph.D., Center for Science Education, Portland State University*



Engineering

The practices of engineering, when combined with Vernier sensors, allow students to identify problems, design solutions, and test those solutions using sensor data.

Vernier supports hands-on engineering activities:

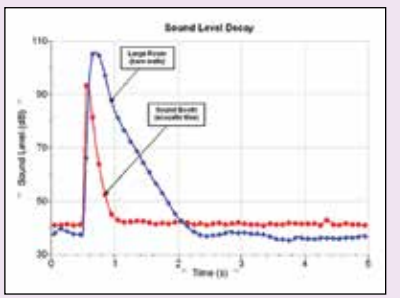
- Engineering design projects
- Feedback and control projects
- Bridge testing and contests
- Structures and materials testing
- Wind energy investigations and design challenges

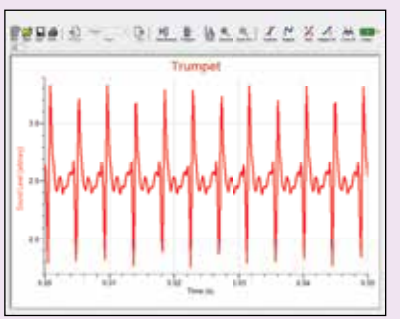
Math

Computational thinking, visualizing data, and recognizing patterns are all part of scientific investigations and engineering activities using Vernier sensors and software.

Engage students in mathematical activities that teach them how to

- Understand grade-level appropriate mathematics and statistics when analyzing data
- Visualize data using a variety of analytical tools to show relationships





Primary Productivity using the Vernier Optical DO Probe and PAR Sensor

BIOLOGY

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1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

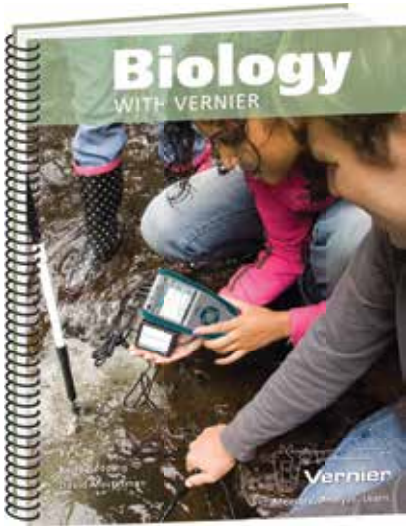
Our Deluxe Package contains all the sensors needed to perform every experiment in our biology lab book.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide



BIOLOGY LAB BOOK

$48 ORDER CODE **BWV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive

- Essential teacher information
- 31 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD
- A generous site license—buy one book and duplicate labs for your class
- Editable labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/bwv**

Biology with Vernier lab book contains the following experiments:

☐ **USING TEMPERATURE PROBES**
- Biodiversity and Ecosystems
- Energy in Food
- Aerobic Respiration
- Dissolved Oxygen in Water
- Watershed Testing
- Physical Profile of a Lake

☐ **USING A GAS PRESSURE SENSOR**
- Testing Catalase Activity
- Transpiration
- Cell Respiration
- Sugar Fermentation
- Effect of Temperature on Fermentation
- Osmosis
- Lactase Action
- Control of Human Respiration

☐ **USING AN EKG SENSOR**
- Monitoring EKG

☐ **USING A HEART RATE MONITOR**
- Heart Rate and Physical Fitness
- Ventilation and Heart Rate

☐ **USING A CO_2 GAS SENSOR**
- ▶ Cell Respiration
- Respiration of Sugars by Yeast
- Effect of Temperature on Respiration
- Temperature of Cold-Blooded Organisms
- Lactase Action
- Photosynthesis and Respiration

☐ **USING A COLORIMETER**
- Photosynthesis
- Alcohol & Biological Membranes
- Biological Membranes
- Population Dynamics

☐ **USING A RESPIRATION MONITOR BELT**
- Control of Human Respiration

☐ **USING AN O_2 GAS SENSOR**
- Photosynthesis and Respiration
- ▶ Enzyme Action
- ▶ Cell Respiration
- Oxygen Gas and Human Respiration
- Cold-Blooded Organisms

☐ **USING A CONDUCTIVITY PROBE**
- Limitations on Cell Size
- Diffusion through Membranes
- Conducting Solutions
- Watershed Testing
- Physical Profile of a Lake

☐ **USING A DISSOLVED OXYGEN PROBE**
- Interdependence of Plants and Animals
- Aerobic Respiration
- Dissolved Oxygen in Water
- Watershed Testing
- Physical Profile of a Lake
- Primary Productivity

☐ **USING A pH SENSOR**
- Acids and Bases
- Interdependence of Plants and Animals
- Acid Rain
- Watershed Testing
- Physical Profile of a Lake

☐ STARTER PACKAGES ☐ DELUXE PACKAGES ▶ VIDEO ONLINE

Biology LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-BIO-ST	Deluxe Package LQ2-BIO-ODX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Hand-Grip Heart Rate Monitor	HGH-BTA	$119	$119
Gas Pressure Sensor	GPS-BTA	$83	$83
CO_2 Gas Sensor	CO2-BTA	$249	$249
O_2 Gas Sensor	O2-BTA		$188
Conductivity Probe	CON-BTA		$95
pH Sensor	PH-BTA		$79
Colorimeter	COL-BTA		$115
Vernier Optical DO Probe*	ODO-BTA		$389
EKG Sensor	EKG-BTA		$147
BioChamber 250	BC-250		$6
BioChamber 2000	BC-2000		$19
Respiration Monitor Belt	RMB		$63
PACKAGE PRICE		**$809**	**$1,910**

YOU MAY ALSO NEED:

Biology with Vernier **lab book,** ORDER CODE **BWV, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,853 EACH AND **SAVE $456!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-BIO-ST	Deluxe Package LM-BIO-ODX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Hand-Grip Heart Rate Monitor	HGH-BTA	$119	$119
Gas Pressure Sensor	GPS-BTA	$83	$83
CO_2 Gas Sensor	CO2-BTA	$249	$249
O_2 Gas Sensor	O2-BTA		$188
Conductivity Probe	CON-BTA		$95
pH Sensor	PH-BTA		$79
Colorimeter	COL-BTA		$115
Vernier Optical DO Probe*	ODO-BTA		$389
EKG Sensor	EKG-BTA		$147
BioChamber 250	BC-250		$6
BioChamber 2000	BC-2000		$19
Respiration Monitor Belt	RMB		$63
PACKAGE PRICE		**$629**	**$1,730**

YOU MAY ALSO NEED:

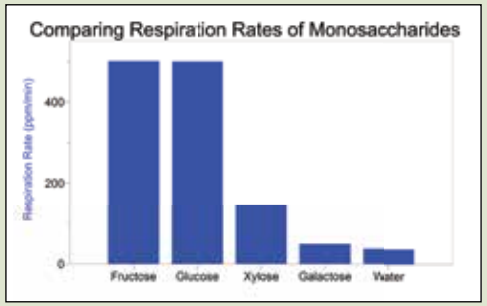
Biology with Vernier **lab book,** ORDER CODE **BWV, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,678 EACH AND **SAVE $416!**

*Deluxe packages substituting a Dissolved Oxygen Probe for the Optical DO Probe are available online.

SUGAR METABOLISM WITH YEAST



Using a CO_2 Gas Sensor to measure the respiration rates of yeast-fed various monosaccharides

AP* BIOLOGY TEACHERS

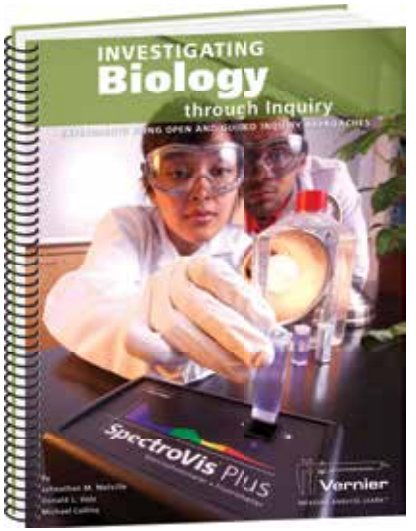
The AP Biology course supports inquiry-based lab experiences for students. Many of the experiments in *Investigating Biology through Inquiry* fit perfectly. We recommend that AP Biology teachers purchase this book. For a complete correlation of Vernier labs with each of the Big Ideas in the AP Biology Framework, visit **www.vernier.com/ap**

IB† BIOLOGY TEACHERS

The International Baccalaureate program has a complete set of objectives for an IB Biology class at the standard level (SL) and the higher level (HL). Many of the experiments in *Investigating Biology through Inquiry* fit perfectly. For a complete correlation of Vernier labs with IB Biology lab objectives, visit **www.vernier.com/ib**

*AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.

†The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.



BIOLOGY INQUIRY LAB BOOK

$48 ORDER CODE **BIO-I** GREAT VALUE!

Investigating Biology through Inquiry will help you integrate inquiry into your curriculum, whether you teach AP*, IB†, or college biology. This inquiry book is designed to meet the new requirements for inquiry in AP biology. This lab book is loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive

- Complete student preliminary activities with step-by-step instructions, data tables, and questions
- Teacher Information sections for each investigation with complete directions for setting up, helpful hints, and sample graphs and data
- Word-processing files of the student sections on a CD so that any investigation may be easily edited to your specifications (Microsoft® Word® files)
- CD that includes both open and guided inquiry approaches to student preliminary activities

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/bio-i**

Investigating Biology through Inquiry lab book includes the following investigations:

USING A TEMPERATURE PROBE
- Water Monitoring
- Sugar Metabolism with Yeast
- Fermentation with Yeast

USING A CONDUCTIVITY PROBE
- Diffusion
- Water Monitoring

USING AN O_2 GAS SENSOR
- Testing Catalase Activity (O_2)

USING A pH SENSOR
- Investigating Buffers
- Water Monitoring

USING A HEART RATE MONITOR
- Heart Rate

USING A CO_2 GAS SENSOR
- Cellular Respiration
- Sugar Metabolism with Yeast
- Evolution of Yeast: Artificial Selection

USING A DISSOLVED OXYGEN SENSOR
- Investigating Dissolved Oxygen
- Investigating Primary Productivity
- Water Monitoring

USING A GAS PRESSURE SENSOR
- Transpiration of Plants
- Testing Catalase Activity (Gas Pressure)
- Investigating Osmosis
- Fermentation with Yeast

USING BIOIMAGING SYSTEMS
- Introduction to Molecular Evolution

USING A SPECTROVIS PLUS
- Plant Pigments
- Chemistry of Membranes
- Photosynthesis of Chloroplasts
- Evolution of Cellobiase in Fungi
- Analysis of Enzymes using Tyrosinase
- Introduction to Biofuels: Enzyme Action
- Investigating Protein: The Bradford Assay

STARTER PACKAGES DELUXE PACKAGES VIDEO ONLINE

Did you know?

Vernier Optical DO Probe, ORDER CODE **ODO-BTA, $389**

The Vernier Optical DO Probe makes it easy to measure the dissolved oxygen concentration in water. Perfect for the field or for the laboratory, this plug-and-play probe requires no calibration, no filling solution, no warm-up time, and no stirring. For more details, see page 47.

Biology Inquiry LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-BINQ-ST	Deluxe Package LQ2-BINQ-ODX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Gas Pressure Sensor	GPS-BTA	$83	$83
SpectroVis Plus Spectrophotometer	SVIS-PL	$469	$469
CO_2 Gas Sensor	CO2-BTA		$249
Conductivity Probe	CON-BTA		$95
Vernier Optical DO Probe*	ODO-BTA		$389
O_2 Gas Sensor	O2-BTA		$188
Hand-Grip Heart Rate Monitor	HGH-BTA		$119
pH Sensor	PH-BTA		$79
PACKAGE PRICE		**$910**	**$2,029**

YOU MAY ALSO NEED:

Investigating Biology through Inquiry **lab book** ORDER CODE **BIO-I, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,968 EACH AND **SAVE $488!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-BINQ-ST	Deluxe Package LM-BINQ-ODX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Gas Pressure Sensor	GPS-BTA	$83	$83
SpectroVis Plus Spectrophotometer	SVIS-PL	$469	$469
CO_2 Gas Sensor	CO2-BTA		$249
Conductivity Probe	CON-BTA		$95
Vernier Optical DO Probe*	ODO-BTA		$389
O_2 Gas Sensor	O2-BTA		$188
Hand-Grip Heart Rate Monitor	HGH-BTA		$119
pH Sensor	PH-BTA		$79
PACKAGE PRICE		**$730**	**$1,849**

YOU MAY ALSO NEED:

Investigating Biology through Inquiry **lab book** ORDER CODE **BIO-I, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,794 EACH AND **SAVE $440!**

*Deluxe packages substituting a Dissolved Oxygen Probe for the Optical DO Probe are available online.

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

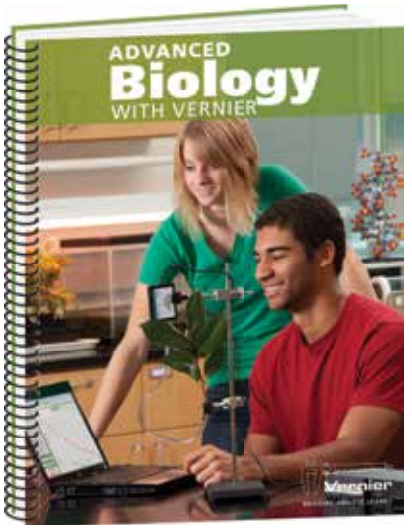
Our Deluxe Package contains all the sensors needed to perform every experiment in our biology lab book.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide



ADVANCED BIOLOGY LAB BOOK

$48 ORDER CODE **BIO-A** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive

- Essential teacher information
- 17 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD
- A generous site license—buy one book and duplicate labs for your class.
- Editable labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/bio-a**

Advanced Biology with Vernier lab book contains the following experiments. (For inquiry-based biology experiments, see page 38.)

☐ **USING A TEMPERATURE PROBE**
- Dissolved Oxygen in Water

☐ **USING A GAS PRESSURE SENSOR**
- Transpiration
- ▶ Cell Respiration
- Osmosis
- Enzyme Action

☐ **USING A CO_2 GAS SENSOR**
- ▶ Cell Respiration

☐ **USING AN O_2 GAS SENSOR**
- ▶ Enzyme Action
- ▶ Cell Respiration

☐ **USING A HEART RATE MONITOR**
- Heart Rate and Physical Fitness

☐ **USING A COLORIMETER OR SPECTROVIS® PLUS SPECTROPHOTOMETER**
- Enzyme Analysis using Tyrosinase
- Introduction to Neurotransmitters using AChE
- Macromolecules: Experiments with Protein
- Photosynthesis

☐ **USING A CONDUCTIVITY PROBE**
- Diffusion through Membranes

☐ **USING A DISSOLVED OXYGEN PROBE**
- Dissolved Oxygen in Water

☐ **USING A SPECTROVIS PLUS SPECTROPHOTOMETER**
- Visible Spectra of Plant Pigments
- Determination of Chlorophyll in Olive Oil
- Enzyme Analysis using Tyrosinase
- Introduction to Neurotransmitters using AChE
- Macromolecules: Experiments with Protein

☐ **USING A BLOOD PRESSURE SENSOR**
- Blood Pressure as Vital Sign

(USING BIOIMAGING SYSTEMS)
- pGLO Bacterial Transformation
- Analysis of Precut Lambda DNA: An Introduction to Restriction Enzymes
- Forensic DNA Fingerprinting

NO SENSOR USED
- Mitosis and Meiosis
- Genetics of Drosophila
- Population Genetics and Evolution
- Animal Behavior

☐ STARTER PACKAGES ☐ DELUXE PACKAGES ▶ VIDEO ONLINE

Did you know?

Hand Dynamometer, ORDER CODE **HD-BTA, $99**

Our strain-gage based, isometric dynamometer can be used to measure grip strength or finger-pinch strength. The Hand Dynamometer makes a great addition to your biology labs. For more details on this sensor, see page 148.

Advanced Biology LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-AB-ST	SpectroVis Plus Deluxe LQ2-AB-OSV
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Gas Pressure Sensor	GPS-BTA	$83	$83
Conductivity Probe	CON-BTA	$95	$95
CO_2 Gas Sensor	CO2-BTA	$249	$249
O_2 Gas Sensor	O2-BTA		$188
Vernier Optical DO Probe*	ODO-BTA		$389
Hand-Grip Heart Rate Monitor	HGH-BTA		$119
Blood Pressure Sensor	BPS-BTA		$105
BioChamber 250	BC-250		$6
SpectroVis Plus Spectrophotometer*	SVIS-PL		$469
PACKAGE PRICE		**$785**	**$2,061**

SPECTROVIS PLUS DELUXE

STARTER

YOU MAY ALSO NEED:

Advanced Biology with Vernier **lab book**
ORDER CODE **BIO-A, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFER: BUY 8 ADVANCED BIOLOGY **SPECTROVIS PLUS** PACKAGES AT $1,999 EACH AND **SAVE $496!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-AB-ST	SpectroVis Plus Deluxe LM-AB-OSV
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
Gas Pressure Sensor	GPS-BTA	$83	$83
Conductivity Probe	CON-BTA	$95	$95
CO_2 Gas Sensor	CO2-BTA	$249	$249
O_2 Gas Sensor	O2-BTA		$188
Vernier Optical DO Probe*	ODO-BTA		$389
Hand-Grip Heart Rate Monitor	HGH-BTA		$119
Blood Pressure Sensor	BPS-BTA		$105
BioChamber 250	BC-250		$6
SpectroVis Plus Spectrophotometer*	SVIS-PL		$469
PACKAGE PRICE		**$605**	**$1,881**

SPECTROVIS PLUS DELUXE

STARTER

YOU MAY ALSO NEED:

Advanced Biology with Vernier **lab book**
ORDER CODE **BIO-A, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

SPECIAL OFFER: BUY 8 ADVANCED BIOLOGY **SPECTROVIS PLUS** PACKAGES AT $1,825 EACH AND **SAVE $448!**

*Deluxe packages substituting a Dissolved Oxygen Probe for the Optical DO Probe and a Colorimeter for the SpectroVis Plus are available online.

$799 (a)

$1,999 (b)

Bio-Rad Forensic DNA Fingerprinting Kit

a. Blue Digital Bioimaging System

ORDER CODE **BL-DBS, $799**

The Blue Digital Bioimaging System is a complete solution for photodocumenting and analyzing your electrophoresis gels. With it, you can

- View your gel banding patterns using the BlueView Transilluminator
- Capture a photograph of the gel on your computer using a ProScope™ HR
- Analyze your results by creating a standard curve and calculating the number of base pairs in each band using Logger *Pro* software (not included)

The Blue Digital Bioimaging System includes a BlueView Transilluminator, Imaging Hood, ProScope HR digital USB camera with 1–10X lens, and a ProScope Stand.

b. Vernier UV-VIS Spectrophotometer

ORDER CODE **VSP-UV, $1,999**

The Vernier UV-VIS Spectrophotometer is a portable ultraviolet and visible light spectrophotometer. It is an easy and accurate instrument ideal for measuring the absorbance spectra of various biochemical compounds. It can also be used to measure DNA and protein purity and for various enzyme kinetic assays. As a USB device, it plugs directly into your computer or LabQuest.

BIO-RAD Bio-Rad Partnership

Vernier and Bio-Rad have partnered to bring you the best in biotechnology kits, instrumentation, consumables, data collection, analysis, and curricula.

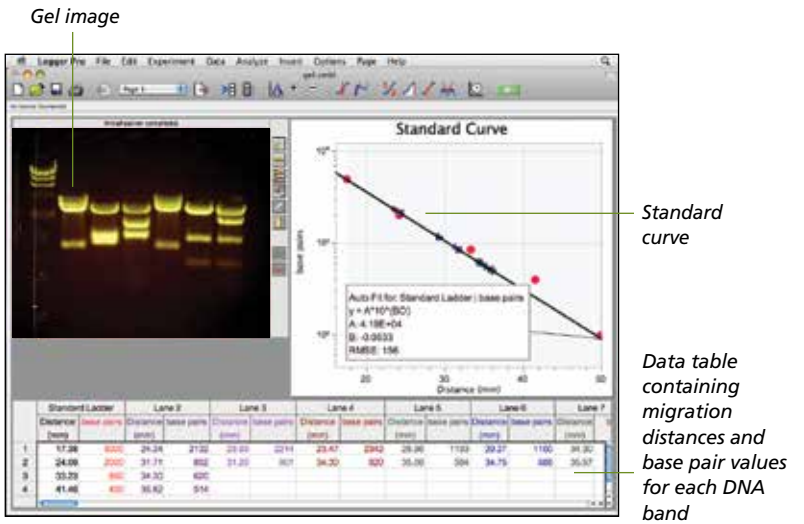
MORE ONLINE – For more information on biotechnology, visit **www.vernier.com/biotech**

Experiment 6B from Advanced Biology with Vernier, *"Analysis of Precut Lambda DNA"*

Three Easy Steps for Gel Analysis

Vernier provides tools for digital photodocumentation and analysis of gel electrophoresis. Here's how it's done:

1. Run your gel.
2. Use our Blue Digital Bioimaging System to capture a digital photo of the gel in Logger *Pro*.
3. Use the Gel Analysis feature in Logger *Pro* to create a standard curve and determine the number of base pairs in each experimental band.


Gel image
Standard Curve
Standard curve
Data table containing migration distances and base pair values for each DNA band

Using the Gel Analysis feature of Logger Pro *3*

"Plant Pigments" from Investigating Biology through Inquiry

SpectroVis® Plus

Spectrophotometer + Fluorometer

$469 ORDER CODE SVIS-PL

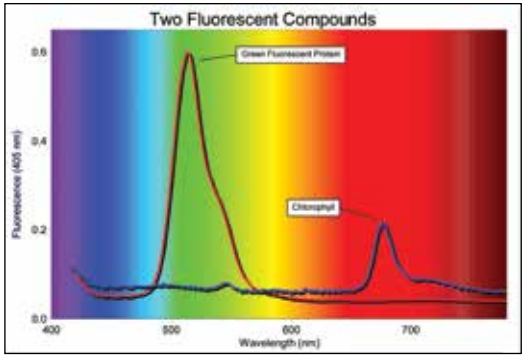
Having an array spectrophotometer/fluorometer combination is now affordable for each of your lab stations! SpectroVis Plus spectrophotometer plus fluorometer allows students to collect absorbance, transmittance, and fluorescence data quickly and easily. In absorbance mode, you can quickly and easily measure the absorbance spectrum of a solution, concentrations of solutions, and rates of reactions. With its two different excitation wavelengths, SpectroVis Plus can measure the fluorescence spectra of many compounds, such as chlorophyll, fluorescein, GFP, and more. Connect SpectroVis Plus to a LabQuest or a computer running Logger *Pro* using a standard USB cable (included), and see the results in full color.

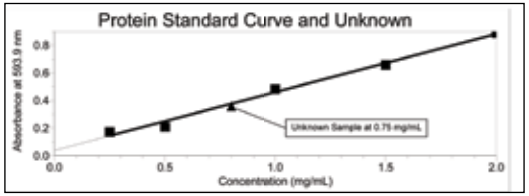
USES

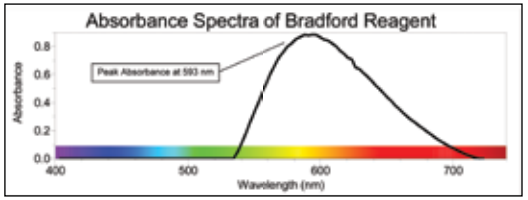
- Measure absorbance spectrum of a liquid
- Measure fluorescence emission spectrum of a liquid
- Conduct Beer's law investigations
- Conduct kinetic studies of absorbance *vs.* time
- Conduct equilibrium studies of absorbance *vs.* time and/or absorbance *vs.* concentration
- Conduct experiments on enzyme kinetics
- Perform colorimetric or fluorescent bioassays
- Use the Optical Fiber (sold separately) to measure light emissions of LEDs, fluorescent bulbs, or incandescent lights. For spectrum tube emissions, we recommend the Vernier Emissions Spectrometer on page 105.

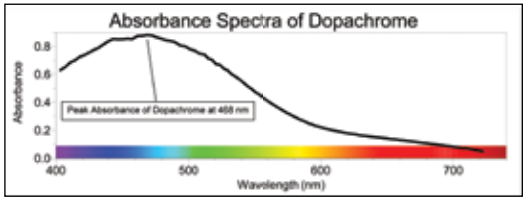
FEATURES

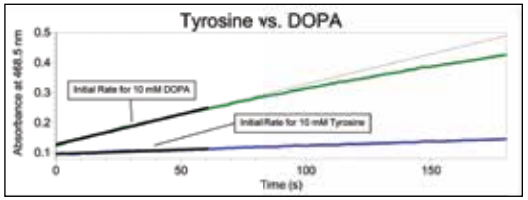
- Portable: 15 cm x 9 cm x 4 cm
- Easy one-step calibration
- Measures absorbance over a 380–900 nm range
- 570 wavelengths, 1 nm reporting intervals
- Fluorescence excitation centered at 405 nm or 500 nm
- Powered by computer or LabQuest USB port; no additional power source needed











Data from spectrometer labs in Advanced Biology with Vernier *and* Investigating Biology through Inquiry

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest and computers.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

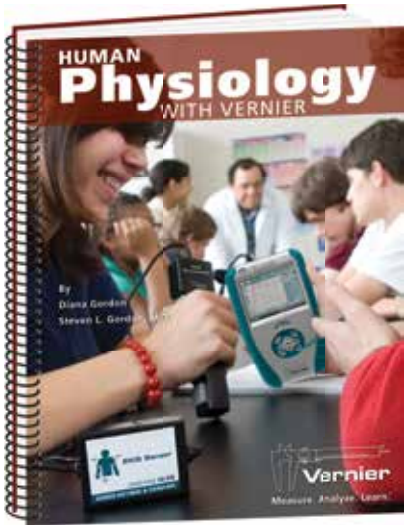
Our Deluxe Package contains all the sensors needed to perform every experiment in our physiology lab book.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide



HUMAN PHYSIOLOGY LAB BOOK

$48 ORDER CODE **HP-A** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive

- Essential teacher information
- 24 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest and computer versions on CD
- A generous site license—buy one book and duplicate labs for your class
- Editable labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/hp-a**

Human Physiology with Vernier lab book contains the following experiments:

USING A SURFACE TEMPERATURE SENSOR
- Warming Function of Nasal Passageways
- Effect of Vascularity on Skin Temperature Recovery

USING A BLOOD PRESSURE SENSOR
- Blood Pressure as a Vital Sign
- Blood Pressure and Exercise
- Diurnal Blood Pressure Variation
- Heart Rate and Blood Pressure as Vital Signs
- Heart Rate, Blood Pressure, and Exercise

USING A HEART RATE MONITOR
- Heart Rate as a Vital Sign
- Heart Rate and Exercise
- Heart Rate Response to Baroreceptor Feedback
- Effect of Coughing on Heart Rate
- Heart Rate and Blood Pressure as Vital Signs
- Heart Rate, Blood Pressure, and Exercise

USING A HAND DYNAMOMETER
- Grip Strength Comparison
- Grip Strength and Muscle Fatigue
- EMG and Muscle Fatigue

USING AN EKG SENSOR
- Analyzing the Heart with EKG
- Introduction to EMG
- Neuromuscular Reflexes (with Accelerometer)
- Neuromuscular Reflexes (without Accelerometer)
- Muscle Function Analysis
- EMG and Muscle Fatigue

USING A SPIROMETER
- Lung Volumes and Capacities
- Respiratory Response to Physiologic Challenges
- Analysis of Lung Function
- Oxygen and Aerobic Metabolism

USING AN O_2 GAS SENSOR
- Oxygen and Aerobic Metabolism
- Oxygen Extraction by the Lungs
- Effect of "Dead Space" on Oxygen Exchange

USING A 25-G ACCELEROMETER
- Neuromuscular Reflexes (with Accelerometer)

STARTER PACKAGES | DELUXE PACKAGES | VIDEO ONLINE

Look for training videos of some of these labs at **www.vernier.com/videos**

Did you know?

Our CO_2 Gas Sensor can be used to measure human respiration. The high range can measure up to 100,000 ppm, while the low range, with a maximum of 10,000 ppm, still gives the precision you need for smaller changes in CO_2 gas concentration. The CO_2 Gas Sensor makes a great addition to your human physiology labs. For more details on this sensor, see page 141.

Human Physiology LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-HP-ST	Deluxe Package LQ2-HP-DLX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
EKG Sensor	EKG-BTA	$147	$147
Hand-Grip Heart Rate Monitor	HGH-BTA	$119	$119
Surface Temperature Sensor	STS-BTA	$23	$23
Blood Pressure Sensor	BPS-BTA	$105	$105
Hand Dynamometer	HD-BTA	$99	$99
Spirometer	SPR-BTA		$199
O_2 Gas Sensor	O2-BTA		$188
O_2 Gas Sensor to Spirometer Adapter	O2-SPR		$8
25-g Accelerometer	ACC-BTA		$92
PACKAGE PRICE		**$822**	**$1,309**

YOU MAY ALSO NEED:

Human Physiology with Vernier **lab book,** ORDER CODE **HP-A, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,270 EACH AND **SAVE $312!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-HP-ST	Deluxe Package LM-HP-DX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
EKG Sensor	EKG-BTA	$147	$147
Hand-Grip Heart Rate Monitor	HGH-BTA	$119	$119
Surface Temperature Sensor	STS-BTA	$23	$23
Blood Pressure Sensor	BPS-BTA	$105	$105
Hand Dynamometer	HD-BTA	$99	$99
Spirometer	SPR-BTA		$199
O_2 Gas Sensor	O2-BTA		$188
O_2 Gas Sensor to Spirometer Adapter	O2-SPR		$8
25-g Accelerometer	ACC-BTA		$92
PACKAGE PRICE		**$642**	**$1,129**

YOU MAY ALSO NEED:

Human Physiology with Vernier **lab book,** ORDER CODE **HP-A, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,095 EACH AND **SAVE $272!**

O_2 Gas Sensor to Spirometer Adapter

ORDER CODE **O2-SPR, $8**

This adapter facilitates the connection between an Oxygen Gas Sensor and a Spirometer. See page 158.

Goniometer

ORDER CODE **GNM-BTA, $159**

The Goniometer measures the angle of a joint. Use it to analyze the range of motion of a limb during different types of physical activity. See page 147.

Force Plate

ORDER CODE **FP-BTA*, $245**

The Force Plate is a large force sensor—tough enough to jump on. Use it to study balance and biomechanics. See page 146.

*Additional shipping charges may apply.

a. Ethanol Sensor, ORDER CODE ETH-BTA, $109

Use the Ethanol Sensor to measure the concentration of ethanol in air above an aqueous sample. It can be used to determine the rate of ethanol production during fermentation or to measure the discrete amount of ethanol in a given sample.

b. Tris-Compatible Flat pH Sensor

ORDER CODE FPH-BTA, $99

The Tris-Compatible Flat pH Sensor uses a double-junction electrode, making it compatible with Tris buffers and solutions containing proteins. The flat glass shape also makes it ideal for measuring the pH of semisolids, such as food or soil.

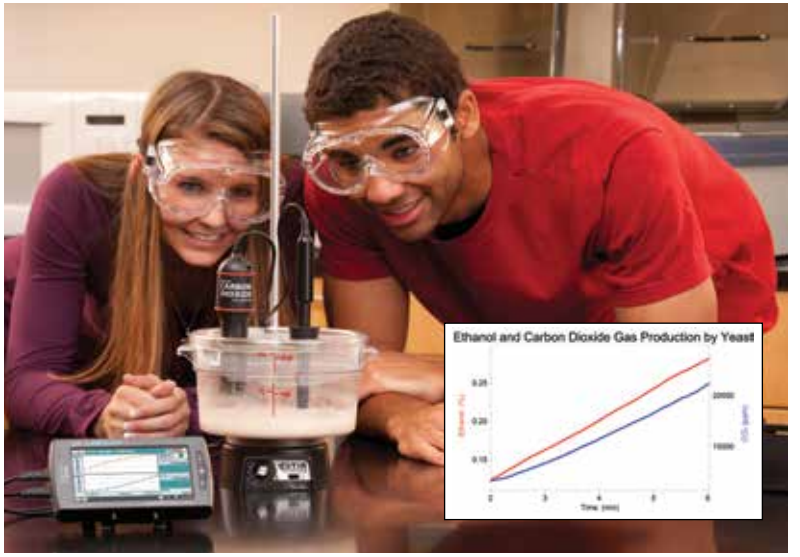
c. PAR Sensor, ORDER CODE PAR-BTA, $189

The PAR (Photosynthetically Active Radiation) Sensor measures photosynthetic light levels in both air and water. It features a waterproof sensor head and can be used to measure Photosynthetic Photon Flux Density (PPFD) from sunlight and electric light sources. It is sensitive to visible light in the spectral range that is used by plants in photosynthesis (400–700 nm). This sensor is ideal for experiments investigating photosynthesis and primary productivity, and can also be used in many agricultural and environmental science applications.

d. BioChambers

2000 mL, ORDER CODE BC-2000, $19
250 mL, ORDER CODE BC-250, $6

BioChambers provide a way for both CO_2 Gas and O_2 Gas Sensors, or one of these along with the Ethanol Sensor, to be used at the same time in a closed system.



Measuring CO_2 gas and ethanol production during fermentation

Measuring photosynthetic light levels and dissolved oxygen concentration in a saltwater aquarium using the PAR Sensor and the Optical DO Probe

Using the Vernier Optical DO Probe to measure primary productivity

WHICH DO PROBE IS RIGHT FOR ME?

	Vernier Optical DO Probe	Dissolved Oxygen Probe
No calibration required	✔	
No stirring required	✔	
No warm-up time	✔	
No electrode filling solution	✔	
Automatic pressure compensation	✔	
Automatic temperature compensation	✔	✔
Measure in mg/L	✔	✔
Measure in % saturation	✔	
Works with LabQuest and LabQuest Mini	✔	✔
Works with Go!Link		✔
Order code	ODO-BTA	DO-BTA
Price	$389	$209

MORE ONLINE – For more information on the Vernier Optical DO Probe, visit **www.vernier.com/odo-bta**

Vernier Optical DO Probe

$389 ORDER CODE **ODO-BTA**

a. Vernier Optical DO Probe, ORDER CODE ODO-BTA, $389

Students can now measure the concentration of dissolved oxygen in water quickly and easily. The Vernier Optical DO Probe uses luminescent technology to provide fast, easy, and accurate measurements of dissolved oxygen concentrations, making it a terrific choice for biology, ecology, or environmental science courses.

- Plug-and-play technology—no filling solution, warm-up time, calibration, or stirring necessary
- Built-in temperature and pressure compensation
- Easy maintenance
- Extended 2-year warranty on the ODO Cap
- Expanded range of 0 to 300% saturation

PRODUCT SPECIFICATIONS

Range: 0 to 20 mg/L, 0 to 300% saturation
Accuracy: ± 0.4 mg/L or better
Accuracy with calibration reset: ± 0.1 mg/L
Response time: 90% of final reading in 40 seconds

ACCESSORIES

b. Optical DO Probe Metal Guard

ORDER CODE **ODO-GRD, $45**

Attach the guard to the Vernier Optical DO Probe to protect the cap and to help weigh down the probe when submerged.

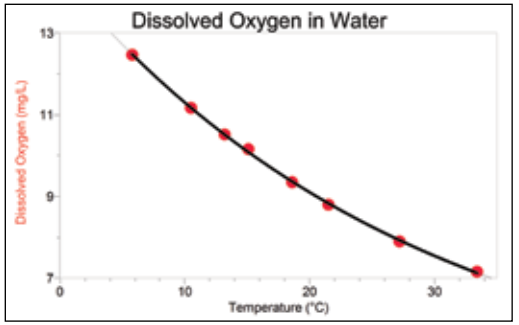
c. Optical DO Probe Replacement Cap*

ORDER CODE **ODO-CAP, $49**

The cap is part of the sensing element. It will need to be replaced every few years.

* Optical DO Probe caps are warranted to be free from defects for a period of two years from the date of purchase; it is possible that you may get somewhat longer use than the warranty period.

a $389



Saturated dissolved oxygen at various temperatures

b $45

c $49

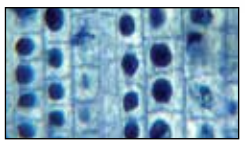
$199 a

Aphid

$149 b

Peacock Feather

NEW $79 c



Onion Root Tip

Digital Microscopes

a. ProScope™ HR, ORDER CODE BD-HRB, $199

The ProScope HR is a USB handheld digital microscope designed for use with your computer and can be used with a Chromebook. With a high-quality CMOS and universal lens mount, the ProScope HR can become a powerful addition to any classroom.

- Instantly displays digital images on a computer or Chromebook
- Takes still photos, movies, and time-lapse videos
- Interchangeable lenses make it easy to get the magnification you need

Includes: ProScope HR Unit, ProScope HR Software, and 50X Lens.

---

b. ProScope Micro Mobile

For iPad: ORDER CODE **BD-PMM-IPADK, $149**
For iPad Air: ORDER CODE **BD-PMM-IPAIRK, $149**
For iPad mini: ORDER CODE **BD-PMM-IPMINIK, $149**

The ProScope Micro Mobile is the first professional-level microscope made for use with iPhone,® iPod touch,® iPad,® iPad Air,™ iPad mini,™ and Galaxy S®4. For additional device options and more information, visit **www.vernier.com/bd-pmm**

---

c. NEW Celestron® Digital Microscope Imager

ORDER CODE **CS-DMI, $79**

The Celestron Digital Microscope Imager turns your traditional compound or stereo microscope into a high-resolution digital imager using a personal computer or Chromebook™. The imager replaces the eyepiece of the microscope and connects directly to your computer or Chromebook.

- Instantly displays digital images on a computer or Chromebook
- Takes still photos, movies, and time-lapse videos
- Included adapter makes it compatible with both compound and dissecting microscopes

Use the ProScope HR as a dissecting scope.

The Celestron Digital Microscope Imager turns your microscope into a high-resolution digital imager.

The imager replaces the eyepiece of the microscope and connects directly to the USB port of your computer or Chromebook.

Experiment 6 from* Chemistry with Vernier, *"Boyle's Law"

CHEMISTRY

Getting Started

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Curriculum

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• Computer

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INQUIRY CHEMISTRY
LabQuest 2 Packages 55
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LabQuest Mini Packages 55
• Computer

ADVANCED CHEMISTRY
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ORGANIC CHEMISTRY 58–59

FEATURED PRODUCTS

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• Melt Station 60
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• Ohaus Balances 64
• Stir Station 64
• Vernier Drop Counter 64
• IMPROVED Colorimeter 64
• NEW Go Wireless pH 65

RELATED SECTIONS

Environmental Science 78–86
Water Quality 120–121
Forensics with Vernier lab book 125

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

Also recommended: *Investigating Chemistry through Inquiry* on page 54.

2 CHOOSE YOUR INTERFACE

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LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

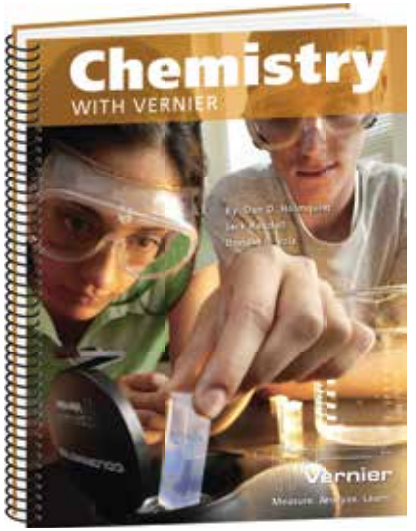
Our Deluxe Package contains all the sensors needed to perform every experiment in our chemistry lab book.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide



CHEMISTRY LAB BOOK

$48 ORDER CODE **CWV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive

- Essential teacher information, including instructions for preparing solutions
- 36 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD
- A generous site license—buy one book and duplicate the labs for your class
- Editable labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/cwv**

Chemistry with Vernier lab book contains the following experiments:

USING TEMPERATURE PROBES
- Endothermic and Exothermic Reactions
- Freezing and Melting of Water
- Another Look at Freezing Temperature
- Heat of Fusion of Ice
- Pressure-Temperature Relationships
- Fractional Distillation
- Evaporation and Intermolecular Attractions
- Vapor Pressure of Liquids
- Effect of Temperature on Solubility
- Finding Molecular Weight
- Energy Content of Foods
- Energy Content of Fuels
- Hess's Law
- Heat of Combustion: Magnesium

USING A pH SENSOR
- Household Acids and Bases
- Acid Rain
- Titration Curves of Acids and Bases
- Acid-Base Titration
- Titration of a Diprotic Acid
- Acid Dissociation Constant, K_a
- Time-Released Vitamin C Tablet
- The Buffer in Lemonade
- Phosphoric Acid Content in Soft Drinks
- Microscale Acid-Base Titration

USING A VOLTAGE PROBE
- Micro-Voltaic Cells
- Lead Storage Batteries

USING A GAS PRESSURE SENSOR
- Boyle's Law: Gas Pressure and Volume
- Pressure-Temperature Relationship
- Vapor Pressure of Liquids

USING A COLORIMETER
- Beer's Law
- Finding an Equilibrium Constant, K_c
- Rate Law Determination of the Crystal Violet Reaction
- Chlorine Content of Swimming Pool Water
- Quantity of Iron in a Vitamin Tablet

USING A CONDUCTIVITY PROBE
- Electrolytes and Non-Electrolytes
- The Effect of Concentration
- Using Conductivity to Find an Equivalence Point

USING A DROP COUNTER *(optional)*
- Acid-Base Titration
- Titration of a Diprotic Acid
- Using Conductivity to Find an Equivalence Point

USING NO SENSOR
- Find the Relationship: An Exercise in Graphical Analysis

STARTER PACKAGES | DELUXE PACKAGES | VIDEO ONLINE

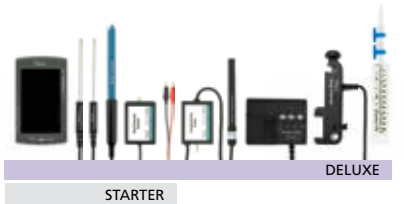
Chemistry LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-CH-ST	Deluxe Package LQ2-CH-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
pH Sensor	PH-BTA	$79	$79
Gas Pressure Sensor	GPS-BTA	$83	$83
Voltage Probe	VP-BTA	$12	$12
Conductivity Probe	CON-BTA		$95
Colorimeter	COL-BTA		$115
Drop Counter	VDC-BTD		$99
PACKAGE PRICE		**$561**	**$870**



YOU MAY ALSO NEED:

Chemistry with Vernier **lab book,** ORDER CODE **CWV, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249**
See pp. 28–31.

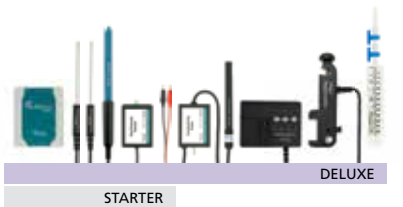
LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $844 EACH AND **SAVE $208**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-CH-ST	Deluxe Package LM-CH-DX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
pH Sensor	PH-BTA	$79	$79
Gas Pressure Sensor	GPS-BTA	$83	$83
Voltage Probe	VP-BTA	$12	$12
Conductivity Probe	CON-BTA		$95
Colorimeter	COL-BTA		$115
Drop Counter	VDC-BTD		$99
PACKAGE PRICE		**$381**	**$690**



YOU MAY ALSO NEED:

Chemistry with Vernier **lab book,** ORDER CODE **CWV, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249**
See pp. 28–31.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $669 EACH AND **SAVE $168**

Also recommended: *Investigating Chemistry through Inquiry* lab book. See page 54.

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. These are Microsoft Word files, so you can edit them for your own AP chemistry lab manual.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended list of sensors for AP Chemistry.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide

NEW AP* CHEMISTRY LAB BOOK

$48 ORDER CODE **APCHEM** GREAT VALUE!

This AP Chemistry lab book makes it easy for AP chemistry teachers to integrate Vernier data-collection technology into the curriculum. When you buy the book you will receive

- Experiments aligned with the College Board's 16 AP Chemistry investigations
- Essential teacher information, including instructions for preparing solutions
- A generous site license—buy one book and duplicate the labs for your class
- Editable labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD
- Suggested answers, sample data, and graphs

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/apchem**

Vernier Chemistry Investigations for Use with AP Chemistry* lab book contains the following experiments:

USING A pH SENSOR
- Investigating Water Hardness

USING A CONDUCTIVITY PROBE
- Investigating Water Hardness
- Identifying an Unknown Substance
- Investigating the Purity of a Mixture

USING A SPECTROVIS PLUS
- Investigating Food Dyes in Sports Beverages
- Determining the Copper Content in Brass
- Separating Molecules
- Investigating the Kinetics of a Crystal Violet Reaction
- Investigating LeChatelier's Principle

USING A GAS PRESSURE SENSOR
- The Effect of Acid Rain on a Marble Structure

USING A pH SENSOR & DROP COUNTER
- The Acidity of Juice and Soft Drinks
- Investigating Acid-Base Titrations
- The Buffering Ability of Commercial Products
- Testing the Effectiveness of a Buffer

USING AN ORP SENSOR & DROP COUNTER
- Determining the Percent Peroxide in a Commercial Product

USING A TEMPERATURE PROBE
- Investigating Commercial Hand Warmers

USING A MELT STATION
- Identifying an Unknown Substance
- Investigating the Components of a Commercial Tablet

Did you know?

Vernier SOFTWARE & TECHNOLOGY AND FLINN

Since 1995, Vernier has partnered with Flinn Scientific, the leading provider of chemistry education products, to provide outstanding support for AP Chemistry lab activities.

Flinn's Advanced Inquiry Laboratory Kits for AP Chemistry will save you prep time, are budget friendly, and are aligned with the inquiry investigations published by the College Board. The cost-saving kit bundle includes 16 kits—one kit for each investigation. Individual kits for each investigation are also available. All Flinn Scientific Advanced Inquiry Laboratory Kits contain the materials needed for 12 student groups to successfully complete the experiment. For more information, visit **www.flinnsci.com**

Products for AP Chemistry

LabQuest 2 or LabQuest Mini

LABQUEST 2
CONNECTED SCIENCE SYSTEM

Standalone, Computer, or Tablet

Computer Only

INTERFACE & SENSORS		CODE	LABQUEST 2	LABQUEST MINI
CHOOSE ONE	**LabQuest 2**	**LABQ2**	$329	—
	LabQuest Mini (computer)	**LQ-MINI**	—	$149
Stainless Steel Temperature Probe		TMP-BTA	$29	$29
pH Sensor		PH-BTA	$79	$79
SpectroVis Plus		SVIS-PL	$469	$469
Conductivity Probe		CON-BTA	$95	$95
ORP Sensor		ORP-BTA	$79	$79
Gas Pressure Sensor		GPS-BTA	$83	$83
Drop Counter		VDC-BTD	$99	$99
Melt Station		MLT-BTA	$469	$469

LABQUEST 2
LABQUEST MINI

YOU MAY ALSO NEED:

***Vernier Chemistry Investigations for Use with AP Chemistry* lab book,** ORDER CODE **APCHEM, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

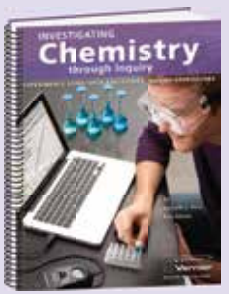
LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

VOLUME DISCOUNTS CALL US AT **888-837-6437** FOR A PRICE QUOTATION

ADDITIONAL RESOURCES:

The AP Chemistry Course Description recommends that teachers engage their students in at least 16 lab experiments, six of which need to be guided inquiry. Many of the experiments in the *Advanced Chemistry with Vernier* and the *Investigating Chemistry through Inquiry* lab books provide additional experiments to supplement the AP Chemistry lab curriculum.

*AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.



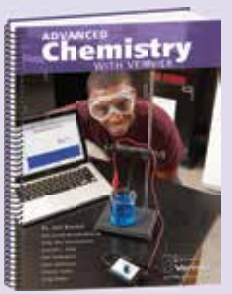
ORDER CODE **CHEM-I**
$48

Investigating Chemistry through Inquiry lab book

This lab book, reviewed and recommended by NSTA, contains 25 inquiry-based chemistry investigations. If you are new to inquiry-based instruction, the extensive teacher section will help guide you through the inquiry-based style of chemistry instruction. Experiments using the following sensors are included.

- Temperature Probe
- pH Sensor
- Colorimeter
- Gas Pressure Sensor
- Conductivity Probe

For a complete list of experiments, see page 54.



ORDER CODE **CHEM-A**
$48

Advanced Chemistry with Vernier lab book

This book contains 35 advanced chemistry experiments designed for use with Vernier probeware. Experiments cover a broad range of topics including

- Stoichiometry
- Gas laws
- Titrations (acid-base, potentiometric)
- Spectroscopy
- Kinetics
- Equilibrium
- Thermodynamics
- Electrochemistry

For a complete list of experiments, see page 56.

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contains both open and guided inquiry investigations.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

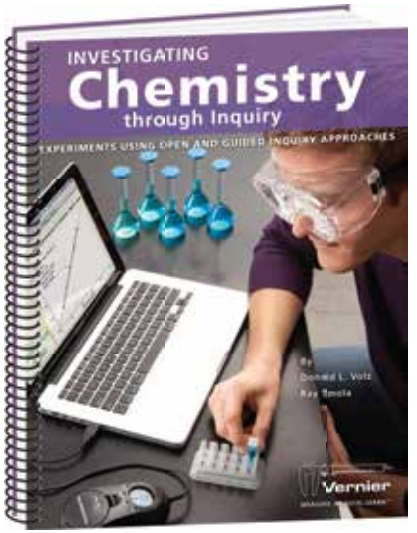
Our Deluxe Packages contain all the sensors needed to perform every experiment in our chemistry lab book.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide



CHEMISTRY INQUIRY LAB BOOK

$48 ORDER CODE **CHEM-I** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive

- 25 inquiry-based, chemistry investigations
- Essential teacher information for successful inquiry investigations
- Suggested researchable questions, sample data, and graphs
- A generous site license—buy one book and duplicate the labs for your class
- Microsoft® Word® files on CD for the experiments so you can easily edit labs to meet your personal teaching style

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/chem-i**

Investigating Chemistry through Inquiry lab book contains the following investigations:

USING A TEMPERATURE PROBE
- ▶ Physical Properties of Water
- Baking Soda and Vinegar Investigations
- An Investigation of Urea-Containing Cold Packs
- Identifying a Pure Substance
- Investigating the Energy Content of Foods
- Investigating the Energy Content of Fuels
- Evaporation and Intermolecular Attractions
- Enthalpy Changes
- Reaction Stoichiometry
- Colligative Properties of Solutions
- Long Term Water Monitoring
- Vapor Pressure and Heat of Vaporization Investigations
- The Effect of Acid Deposition on Aqueous Systems
- Baking Soda and Vinegar Investigations Revisited
- Reaction Rates
- ▶ Enzyme Activity
- Sugar Fermentation by Yeast

USING A GAS PRESSURE SENSOR
- Vapor Pressure and Heat of Vaporization Investigations
- Baking Soda and Vinegar Investigations Revisited
- Reaction Rates
- Enzyme Activity
- Sugar Fermentation by Yeast

USING A pH SENSOR
- Long Term Water Monitoring
- Acid-Base Properties of Household Products
- The Effect of Acid Deposition on Aqueous Systems
- ▶ Acid-Base Titrations
- Baking Soda and Vinegar Investigations Revisited

USING A VOLTAGE PROBE
- Investigating Voltaic Cells

USING A CONDUCTIVITY SENSOR
- ▶ Conductivity of Aqueous Solutions
- Long Term Water Monitoring
- Conductimetric Titrations

USING A COLORIMETER OR SPECTROVIS PLUS
- ▶ Beer's Law Investigations

USING AN ORP SENSOR
- Oxidation-Reduction Titrations

USING A RADIATION MONITOR
- Nuclear Radiation

▶ VIDEO ONLINE

IB* CHEMISTRY TEACHERS – The International Baccalaureate program has a complete set of objectives for an IB Chemistry class at the standard level (SL) and the higher level (HL). Many of the experiments in the *Investigating Chemistry through Inquiry* and *Advanced Chemistry with Vernier* lab books fit perfectly. We recommend that IB Chemistry teachers purchase both of these books. For a complete correlation of Vernier labs with IB Chemistry lab objectives, visit **www.vernier.com/ib**

*The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.

Chemistry Inquiry LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS		CODE	Colorimeter Deluxe **LQ2-CMI-DX**	SpectroVis Plus Deluxe **LQ2-CMI-SV**
Vernier LabQuest 2 Interface		**LABQ2**	$329	$329
Stainless Steel Temperature Probe		TMP-BTA	$29	$29
pH Sensor		PH-BTA	$79	$79
Gas Pressure Sensor		GPS-BTA	$83	$83
Conductivity Probe		CON-BTA	$95	$95
Drop Counter		VDC-BTD	$99	$99
ORP Sensor		ORP-BTA	$79	$79
CHOOSE ONE	**Colorimeter** or	COL-BTA	$115	—
	SpectroVis Plus Spectrophotometer	SVIS-PL	—	$469
PACKAGE PRICE			**$908**	**$1,262**

YOU MAY ALSO NEED:

Investigating Chemistry through Inquiry **lab book** ORDER CODE **CHEM-I, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249**
See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFERS: BUY 8 **COLORIMETER** PACKAGES AT $881 EACH AND **SAVE $216!** | BUY 8 **SPECTROVIS PLUS** PACKAGES AT $1,224 EACH AND **SAVE $304!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS		CODE	Colorimeter Deluxe **LM-CMI-DX**	SpectroVis Plus Deluxe **LM-CMI-SV**
Vernier LabQuest Mini Interface		**LQ-MINI**	$149	$149
Stainless Steel Temperature Probe		TMP-BTA	$29	$29
pH Sensor		PH-BTA	$79	$79
Gas Pressure Sensor		GPS-BTA	$83	$83
Conductivity Probe		CON-BTA	$95	$95
Drop Counter		VDC-BTD	$99	$99
ORP Sensor		ORP-BTA	$79	$79
CHOOSE ONE	**Colorimeter** or	COL-BTA	$115	—
	SpectroVis Plus Spectrophotometer	SVIS-PL	—	$469
PACKAGE PRICE			**$728**	**$1,082**

YOU MAY ALSO NEED:

Investigating Chemistry through Inquiry **lab book** ORDER CODE **CHEM-I, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249**
See pp. 28–31.

SPECIAL OFFERS: BUY 8 **COLORIMETER** PACKAGES AT $706 EACH AND **SAVE $176!** | BUY 8 **SPECTROVIS PLUS** PACKAGES AT $1,050 EACH AND **SAVE $256!**

STARTER PACKAGES for chemistry inquiry are available online at www.vernier.com/packages/inquiry-chemistry

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

Also recommended: *Investigating Chemistry through Inquiry* page 54.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

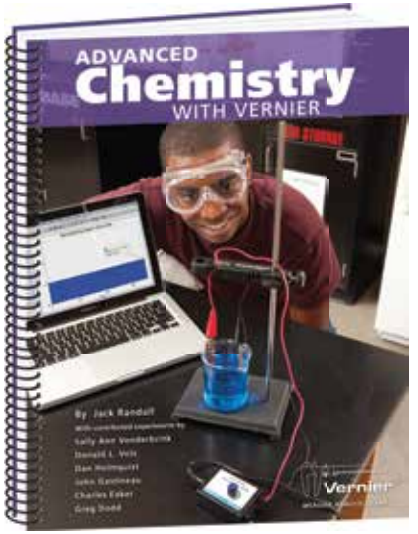
Our Deluxe Packages contain all the sensors needed to perform every experiment in our chemistry lab book.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide



ADVANCED CHEMISTRY LAB BOOK

$48 ORDER CODE **CHEM-A** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive

- Essential teacher information, including instructions for preparing solutions
- 35 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD
- A generous site license—buy one book and duplicate the labs for your class
- Editable labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/chem-a**

Advanced Chemistry with Vernier lab book contains the following experiments:

USING TEMPERATURE PROBES
- Using Freezing-Point Depression to Find Molecular Weight
- The Molecular Mass of a Volatile Liquid
- Molar Volume of a Gas
- Vapor Pressure and Heat of Vaporization
- Rate Determination and Activation Energy
- Synthesis and Analysis of Aspirin
- Exploring the Properties of Gases
- Determining the Mole Ratios in a Chemical Reaction
- Determining the Enthalpy of a Chemical Reaction
- Synthesis and Analysis of Alum
- The Enthalpy of Neutralization of Phosphoric Acid

USING A pH SENSOR
- Standardizing a Solution of Sodium Hydroxide
- Buffers
- Determining the K_{sp} of Calcium Hydroxide
- Determining K_a by the Half Titration of a Weak Acid

USING A COLORIMETER OR SPECTROVIS PLUS
- The Determination of an Equilibrium Constant
- Determining the Concentration of a Solution: Beer's Law
- The Rate and Order of a Chemical Reaction
- The Synthesis and Analysis of Aspirin
- Rate Determination and Activation Energy

USING A pH SENSOR AND DROP COUNTER
- Acid-Base Titration
- Investigating Indicators

USING A VOLTAGE PROBE
- Electrochemistry: Voltaic Cells

USING A GAS PRESSURE SENSOR
- The Decomposition of Hydrogen Peroxide
- The Molar Volume of a Gas
- Exploring the Properties of Gases
- Vapor Pressure and Heat of Vaporization

USING A CONDUCTIVITY PROBE & DROP COUNTER
- Conductimetric Titration and Gravimetric Determination
- The Base Hydrolysis of Ethyl Acetate

USING AN ORP SENSOR & DROP COUNTER
- An Oxidation-Reduction Titration: Fe^{2+} and Ce^{4+}
- Potentiometric Titration of Hydrogen Peroxide

CONSTANT CURRENT SYSTEM
- Electroplating
- Avogadro's Number

USING A RADIATION MONITOR
- Alpha, Beta, and Gamma
- Radiation Shielding
- Half-Life Determination

NO SENSOR USED
- The Determination of a Chemical Formula
- The Determination of the Percent Water in a Compound
- Separation and Qualitative Analysis of Cations
- Liquid Chromatography

VIDEO ONLINE

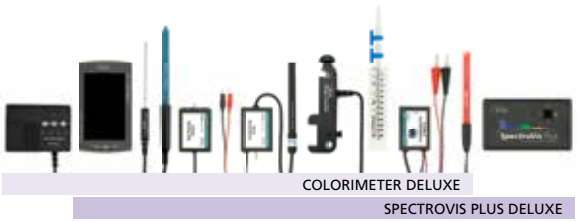
Advanced Chemistry LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS		CODE	Colorimeter Deluxe **LQ2-CHMA-DLX**	SpectroVis Plus Deluxe **LQ2-CHMA-SV**
Vernier LabQuest 2 Interface		**LABQ2**	$329	$329
Stainless Steel Temperature Probe		TMP-BTA	$29	$29
pH Sensor		PH-BTA	$79	$79
Gas Pressure Sensor		GPS-BTA	$83	$83
Voltage Probe		VP-BTA	$12	$12
Conductivity Probe		CON-BTA	$95	$95
Drop Counter		VDC-BTD	$99	$99
Constant Current System		CCS-BTA	$59	$59
ORP Sensor		ORP-BTA	$79	$79
CHOOSE ONE	**Colorimeter** or	COL-BTA	$115	—
	SpectroVis Plus Spectrophotometer	SVIS-PL	—	$469
PACKAGE PRICE			**$979**	**$1,333**



COLORIMETER DELUXE

SPECTROVIS PLUS DELUXE

YOU MAY ALSO NEED:

Advanced Chemistry with Vernier **lab book** ORDER CODE **CHEM-A, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249**
See pp. 28–31.

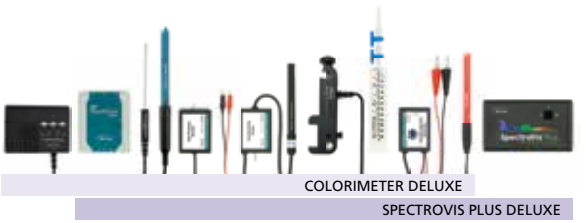
LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFERS:	BUY 8 **COLORIMETER** PACKAGES AT $950 EACH AND **SAVE $232!**	BUY 8 **SPECTROVIS PLUS** PACKAGES AT $1,293 EACH AND **SAVE $320!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS		CODE	Colorimeter Deluxe **LM-CHMA-DX**	SpectroVis Plus Deluxe **LM-ACSV-DX**
Vernier LabQuest Mini Interface		**LQ-MINI**	$149	$149
Stainless Steel Temperature Probe		TMP-BTA	$29	$29
pH Sensor		PH-BTA	$79	$79
Gas Pressure Sensor		GPS-BTA	$83	$83
Voltage Probe		VP-BTA	$12	$12
Conductivity Probe		CON-BTA	$95	$95
Drop Counter		VDC-BTD	$99	$99
Constant Current System		CCS-BTA	$59	$59
ORP Sensor		ORP-BTA	$79	$79
CHOOSE ONE	**Colorimeter** or	COL-BTA	$115	—
	SpectroVis Plus Spectrophotometer	SVIS-PL	—	$469
PACKAGE PRICE			**$799**	**$1,153**



COLORIMETER DELUXE

SPECTROVIS PLUS DELUXE

YOU MAY ALSO NEED:

Advanced Chemistry with Vernier **lab book** ORDER CODE **CHEM-A, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249**
See pp. 28–31.

SPECIAL OFFERS:	BUY 8 **COLORIMETER** PACKAGES AT $775 EACH AND **SAVE $192!**	BUY 8 **SPECTROVIS PLUS** PACKAGES AT $1,118 EACH AND **SAVE $280!**

STARTER PACKAGES for advanced chemistry are available online at www.vernier.com/packages/advanced-chemistry

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. These are Microsoft Word files, so you can edit them for your own organic chemistry lab manual.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

3 CHOOSE YOUR SENSORS

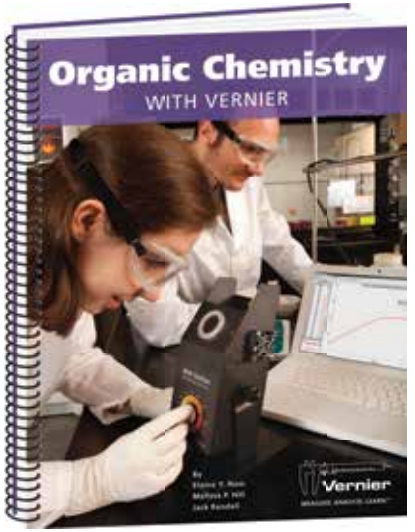
Choose from Vernier's recommended list of sensors for organic chemistry.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide



ORGANIC CHEMISTRY LAB BOOK

$48 ORDER CODE **CHEM-O** GREAT VALUE!

This college-level book makes it easy for organic chemistry instructors to integrate Vernier data-collection technology into the organic chemistry lab curriculum. When you buy the lab book you will receive

- Complete student experiments with materials list, step-by-step instructions, data tables, and questions
- Instructor Information section for each experiment with directions for setting up experiments, helpful hints, and sample graphs and data
- Word-processing files of the student pages on a CD so that any experiment may be easily edited to your specifications (Microsoft® Word® files)
- Generous site license—buy one book and duplicate experiments for your class
- Complete equipment and chemicals list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/chem-o**

Organic Chemistry with Vernier lab book contains the following experiments:

USING A MELT STATION
- Determining Melting Temperature
- Recrystallization of Benzoic Acid and Aspirin
- Identifying an Unknown Analgesic by Melting Temperature and Thin-Layer Chromatography
- Separation of Organic Compounds by Acid-Base Extraction Techniques
- The Synthesis and Analysis of Aspirin
- Synthesis of Dibenzalacetone by Aldol Condensation
- The Diels-Alder Reaction of Anthracene with Maleic Anhydride
- Friedel-Crafts Acylation of Ferrocene

USING A MINI GAS CHROMATOGRAPH
- Fractional Distillation of Esters
- Investigating Gas Chromatography
- Understanding Intermolecular Forces Using a Gas Chromatograph: Enthalpy of Vaporization
- Investigating Thermodynamic Relationships of Substituted Hydrocarbons
- Synthesizing Ethyl Acetate by Fisher Esterification
- Using a Gas Chromatograph: Identifying an Unknown Compound
- S_N1: Synthesis of t-butyl chloride
- S_N2: Synthesis of 1-bromobutane

USING A SPECTROVIS PLUS
- Extraction of Spinach Pigments and Analysis by Electronic Absorption Spectroscopy
- The Synthesis and Analysis of Aspirin
- Grignard Formation of Crystal Violet
- Synthesis of Fluorescein
- Synthesis of Methyl Orange and Its Application to Textiles

USING A POLARIMETER
- Understanding Polarimetry
- Identification of Organic Unknowns Using Polarimetry
- Observing the Reaction Kinetics of Sucrose with Polarimetry
- Isolation and Epoxidation of a Natural Product: Limonene
- Analysis of Natural Products

USING A WIDE-RANGE TEMPERATURE PROBE
- Determination of a Boiling Point: Simple and Fractional Distillation
- Fractional Distillation of Esters
- The Synthesis and Analysis of Aspirin
- Isolation and Epoxidation of a Natural Product: Limonene
- Synthesis of Dibenzalacetone by Aldol Condensation
- The Diels-Alder Reaction of Anthracene with Maleic Anhydride
- Friedel-Crafts Acylation of Ferrocene
- Synthesis of Fluorescein

Products for Organic Chemistry

LabQuest 2 or LabQuest Mini	INTERFACE & SENSORS		CODE	LABQUEST 2	LABQUEST MINI
LabQuest 2 CONNECTED SCIENCE SYSTEM	CHOOSE ONE	LabQuest 2	LABQ2	$329	—
		LabQuest Mini (computer)	LQ-MINI	—	$149
	Wide-Range Temperature Probe		WRT-BTA	$79	$79
	Melt Station		MLT-BTA	$469	$469
	Polarimeter (Chemical)		CHEM-POL	$499	$499
	SpectroVis Plus (VIS-NIR spectrometer)		SVIS-PL	$469	$469
	Mini GC Plus		GC2-MINI	$1,989	$1,989

Standalone, Computer, or Tablet

Computer Only

YOU MAY ALSO NEED:

Organic Chemistry with Vernier **lab book** ORDER CODE **CHEM-O, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

VOLUME DISCOUNTS CALL US AT **888-837-6437** FOR A PRICE QUOTATION

ONLY $1,999

VERNIER UV-VIS SPECTROPHOTOMETER

ORDER CODE **VSP-UV, $1,999**

The Vernier UV-VIS Spectrophotometer is a portable ultraviolet and visible light spectrophotometer appropriate for advanced high school, college, and graduate level education. As a USB device, it plugs directly into your computer or LabQuest. Each Vernier UV-VIS Spectrophotometer includes an AC power supply, two Starna quartz cuvettes, USB cable, and user manual.

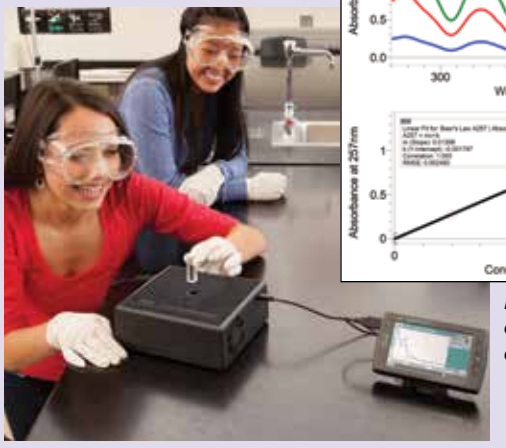
Product Specifications

Wavelength Range: 220-850 nm
Wavelength Reporting Interval: ~1 nm
Photometric Accuracy‡: ±5.0%
Wavelength Accuracy†: ±2.0 nm
Light Source: deuterium (UV) and incandescent (VIS)

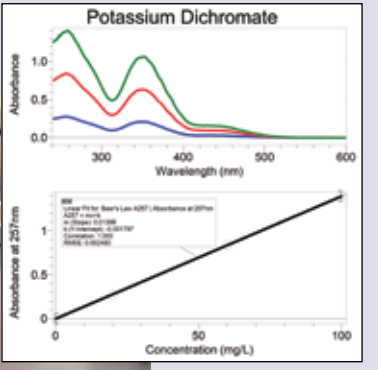
† As determined with holmium oxide NIST standard ‡ As determined with potassium dichromate NIST standards

Quartz Cuvettes (pkg 2), ORDER CODE **CUV-QUARTZ, $159**

MORE ONLINE – Downloadable experiments are available for free online at **www.vernier.com/vsp-uv**



Examining the absorbance spectrum of potassium dichromate using the Vernier UV-VIS Spectrophotometer and LabQuest 2



Beer's law plot of potassium dichromate

a. Chemical Polarimeter

ORDER CODE **CHEM-POL, $499**

The Chemical Polarimeter is a device used for measuring the rotation of plane-polarized light caused by an optically active substance without chemically modifying or destroying the sample. This is a vertical polarimeter that uses an integrated 589 nm LED, a fixed polarizer, and a manually rotated polarizer to detect changes in rotation of plane-polarized light.

- Light and angle sensors log light transmission *versus* angle over 360° of rotation.
- Digital optical encoder and analysis tools (in Logger *Pro* computer software and LabQuest) enable determination of specific rotation to ±1°.
- Includes custom sample cell with pour spout and height scale.
- Powered by computer (interface required) or LabQuest—no power cord!

MORE ONLINE – Downloadable experiments are available for free at **www.vernier.com/chem-pol**

b. Melting Temperature Sensor

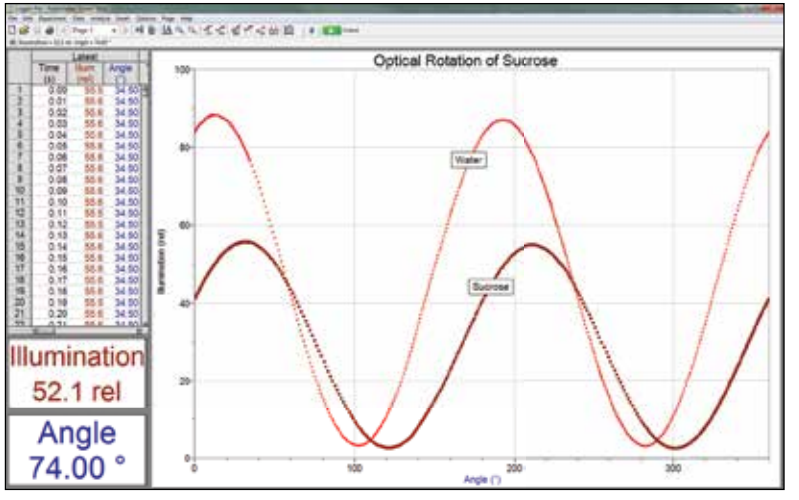
ORDER CODE **MLT-BTA, $469**

The Melt Station connects to LabQuest, LabQuest Mini, Go!Link, or LabPro. Use it to measure the melting temperature of solid substances.

- Accurate results using a built-in RTD sensor over a range of 30°C to 260°C
- High-quality 6X viewing lens for clear observation of the samples
- Innovative, adjustable tilt allows for optimal viewing angle
- Cooling fan reduces time between tests

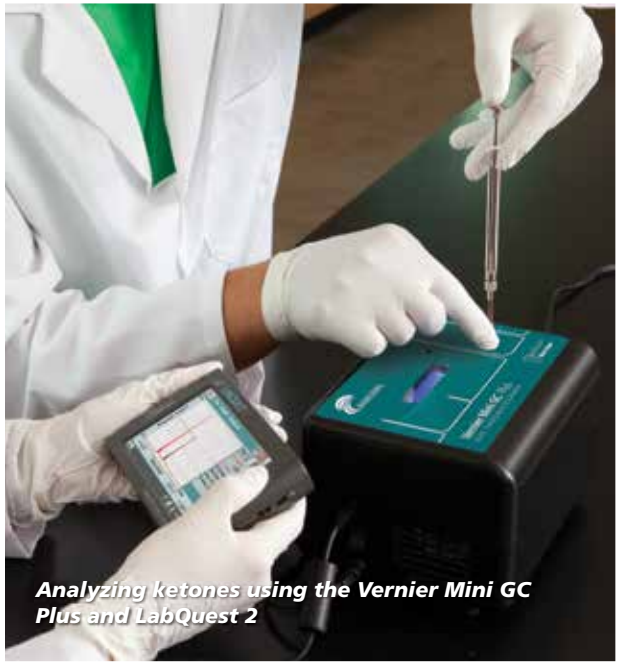
MORE ONLINE – **www.vernier.com/mlt-bta**

Analyzing the optical rotation of sucrose using the Polarimeter and LabQuest 2



Logger Pro *allows easy detection of the optical rotation of compounds like sucrose.*

Analyzing ketones using the Vernier Mini GC Plus and a computer running Logger Pro



Analyzing ketones using the Vernier Mini GC Plus and LabQuest 2

Vernier Mini GC® Plus

$1,989 ORDER CODE GC2-MINI

Use Room Air as a Carrier Gas – Our advanced MEMS GC chip technology allows you to use room air as the carrier gas.

Connect to a Computer or LabQuest via USB – Connects to both Windows and Macintosh computers and LabQuest.

Use Our Award-Winning Software for Analysis – With either Logger *Pro* for computers or LabQuest App, peak integration analysis and retention-time determination are built right into the software.

FEATURES OF THE MINI GC PLUS

The Mini GC Plus can detect a variety of compounds. The features that make this possible include:

- A maximum column temperature of 160°C, offering flexibility in designing temperature profiles.
- The MEMS chip sensor can be set at either of two levels of sensitivity.
  - Standard sensitivity mode works well for polar compounds such as ketones, alcohols, and esters.
  - High sensitivity mode works well for compounds such as halogenated alkanes and substituted aromatics, as well as mixtures with one or more compound of low concentration.

Includes Lab Book – Features five experiments suitable for high school or college organic chemistry.

The Mini GC Plus is covered by a two-year warranty (syringe, column, sensor, and septa excluded).

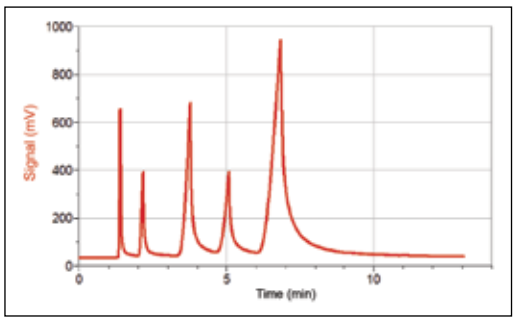
ACCESSORIES

GC Septa (pkg 4)
ORDER CODE **GC-SEP, $29**

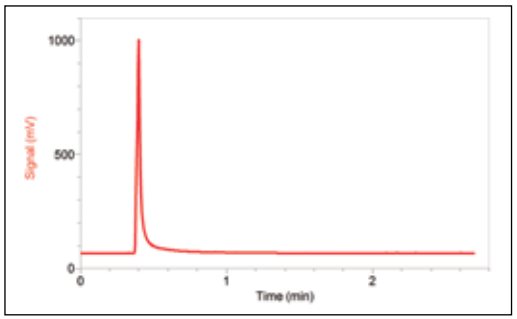
GC Syringe, 1 µL Hamilton
ORDER CODE **GC-SYR-MIC, $84**

MORE ONLINE – For more information about the Mini GC Plus, visit **www.vernier.com/gc2-mini**

See training video at **www.vernier.com/videos**



Mini GC Plus chromatogram of a ketone mixture



Mini GC Plus chromatogram of 1-chlorobutane

Spectrometer Accessories

CUVETTES

Plastic Cuvettes package of 100 (visible range)
ORDER CODE **CUV, $15**
(Use with Vernier Spectrometer and SpectroVis Plus)

Quartz Cuvettes package of two
ORDER CODE **CUV-QUARTZ**
$159 (Use with Vernier UV-VIS)

Cuvette Rack
ORDER CODE **CUV-RACK, $9**

OPTICAL FIBERS

Optical fibers for spectrometers are available online at **www.vernier.com/spectrometers**

Did you know?

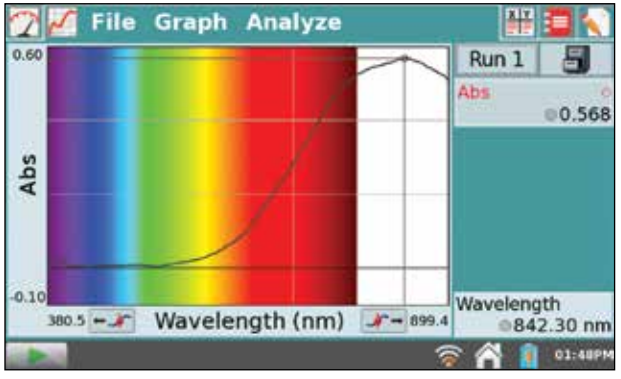
The Vernier Emissions Spectrometer is the perfect tool to conduct emissions analysis. It connects directly to your computer or LabQuest with a standard USB cable and gives precise measurements over a range of 350–900 nm. Use the Vernier Emissions Spectrometer with or without an optical fiber to examine spectra of light bulbs, spectrum tubes, or the sun. For details, visit **www.vernier.com/vsp-em**

Spectrometers

	SpectroVis Plus	Vernier Spectrometer (Ocean Optics™ powered)	Vernier UV-VIS
Specs	• Wavelength range: 380–900 nm • Wavelength accuracy: ±7.0 nm (450 nm) ±3.0 nm (650 nm) • VIS-NIR • 1 nm between reported values	• Wavelength range: 380–950 nm • Wavelength accuracy: ±2.0 nm • VIS-NIR • 2 nm between reported values	• Wavelength range: 220–850 nm • Wavelength accuracy: ±2.0 nm • UV-VIS • 1 nm between reported values
Light Source & Sample Holder	Integrated sample holder and LED-boosted tungsten source. The sample holder takes standard 1 cm cuvettes. Additional LEDs allow for fluorescence spectra with excitation at 405 nm and 500 nm.	Combination sample holder and LED-boosted tungsten source. The sample holder takes standard 1 cm cuvettes.	Integrated sample holder with deuterium (UV) and tungsten (VIS) light source. The sample holder takes standard 1 cm cuvettes.
Items Included*	• Spectrophotometer • 15 plastic cuvettes with lids • USB cable • Connects by USB to a computer or LabQuest interface; no additional power source needed	• Spectrophotometer • Light source and cuvette holder • 15 plastic cuvettes with lids • USB cable • Connects by USB to a computer or LabQuest interface; no additional power source needed	• Spectrophotometer • Two Starna quartz cuvettes • USB cable • AC power supply • Connects by USB to a computer or LabQuest interface
Warranty	5 years (3 years light source)	3 years (1 year light source)	5 years (1 year light source)
Price	$469 ORDER CODE **SVIS-PL***	$1,499 ORDER CODE **V-SPEC***	$1,999 ORDER CODE **VSP-UV***

* Software needed: Logger *Pro* or LabQuest App

Examining the absorbance spectrum of copper (II) sulfate using SpectroVis Plus and LabQuest 2



Spectrum of copper (II) sulfate

SpectroVis® Plus

$469 ORDER CODE SVIS-PL

An Affordable Spectrophotometer and Fluorometer

Having a CCD array spectrometer/fluorometer combination is now affordable for each of your lab stations! Array spectrometer technology allows you to collect a full wavelength spectrum (absorbance, percent transmittance, or intensity) in less than one second. Once the peak wavelength is determined, you can easily determine the concentration of a solution (Beer's law) or monitor rates of reaction.

PRODUCT SPECIFICATIONS

Wavelength Range: 380–900 nm (VIS-NIR)
Wavelength Reporting Internal: ~1 nm
Wavelength Accuracy†: ±7.0 nm (450 nm), ±3.0 nm (650 nm)
Photometric Accuracy‡: ±13%
Light Source: Incandescent, LEDs
Fluorescence: Two excitation sources centered at 405 nm and 500 nm
Dimensions: 15 cm x 9 cm x 4 cm

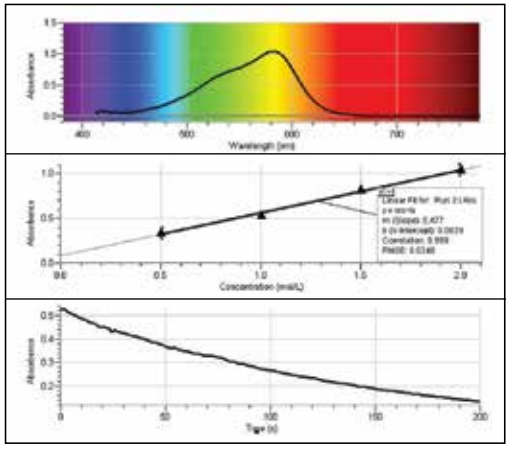
† As determined with holmium oxide NIST standard
‡ As determined with nickel sulfate

FEATURES

- Collect a full spectrum in less than 1 second
- Easy one-step calibration
- Connects directly to LabQuest or to a computer's USB port
- No external power required
- Use the Optical Fiber (sold separately) to measure light emissions of LEDs, fluorescent bulbs, or incandescent lights. For spectrum tube emissions, we recommend the Vernier Emissions Spectrometer on page 105.

WHICH SPECTROMETER IS RIGHT FOR YOU?

It is important to keep in mind all the applications for which you might want to use your spectrometer. We offer spectrometers that measure absorbance, fluorescence, and/or emissions with varying degrees of resolution. To help you decide which one is right for you, see our Spectrometer comparison graphs at **www.vernier.com/spectracomparison**



Absorbance spectrum of crystal violet

IMPROVED

a

$115

b

$129

- *Three LEDs light up solutions*
- *Can be used with AC power or four C batteries*

c

$99

d

a. IMPROVED Colorimeter, ORDER CODE COL-BTA, $115

Conduct kinetics and Beer's law experiments using this 4-wavelength (430, 470, 565, and 635 nm) colorimeter featuring a one-button calibration. Offering better protection against spills in the cuvette slot, the Colorimeter accepts all standard 10 mm pathlength cuvettes. Fifteen 3.5 mL cuvettes are included.

b. Stir Station, ORDER CODE STIR, $129

The Stir Station is a high-quality, multi-function magnetic stirrer. It has a stirring capacity of 800 mL in a 1 L beaker. It works efficiently with beakers with a volume as small as 50 mL and with a wide range of sizes and shapes of magnetic stirring bars. Includes Stir Station, Vernier Microstirrer (see page 163), magnetic stirring bar, AC power adapter, and removable ring-stand post. Can be used with AC power or four C batteries.

c. Vernier Drop Counter, ORDER CODE VDC-BTD, $99

The Vernier Drop Counter allows your students to conduct titrations precisely, effectively, and hands free in less time. Features include

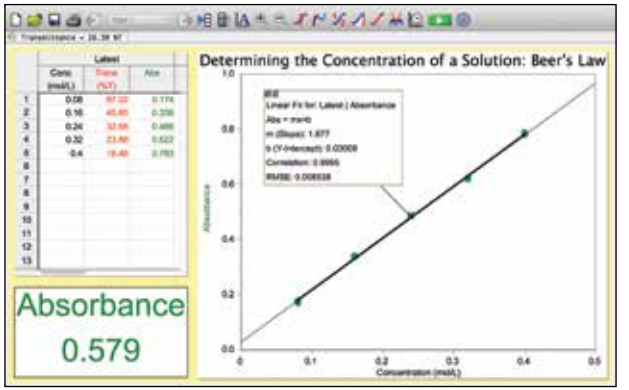
- Wide drop-detecting area
- Red LED, near the detecting area, flashes to indicate a drop has been recorded
- Accurate drop counting at rates up to 6 drops/second
- Adjustable clamp; fits most laboratory ring stands and lattices

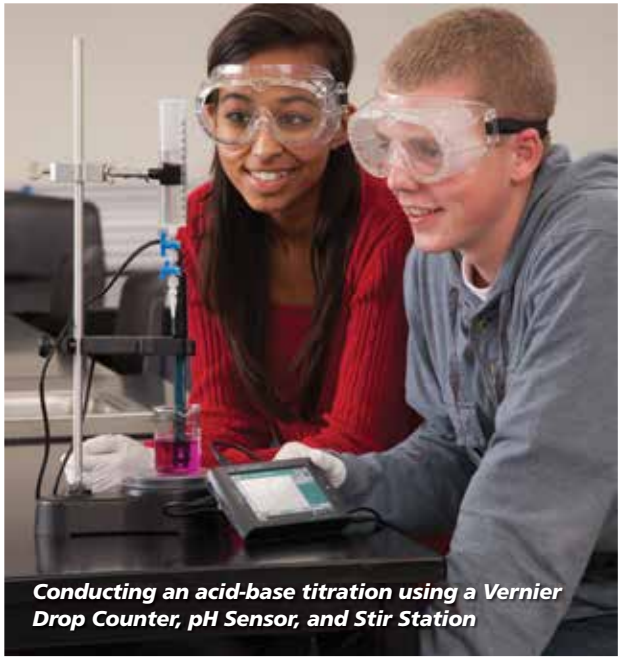
d. Ohaus® Scout™ Pro Balances

It is easy to collect mass data from an Ohaus Scout Pro balance using our popular Logger *Pro* 3 software or LabQuest 2. Simply connect a Scout Pro balance to the USB port using the USB connection kit, start the software, and collect real-time data as if the Ohaus balance was just another Vernier sensor!

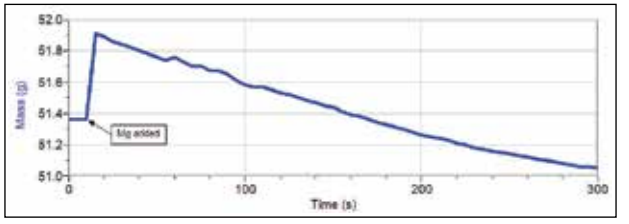
Scout Pro 0.01 g balance (200 g) ORDER CODE **OHSP-202, $362**
Scout Pro 0.01 g balance (400 g) ORDER CODE **OHSP-402, $486**
Scout Pro 0.001 g balance (120 g) ORDER CODE **OHSP-123, $475**

All three balances require:
Scout Pro USB connection kit ORDER CODE **OHSP-USB, $113**



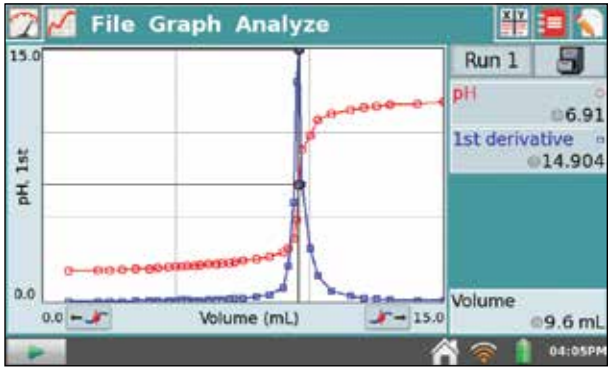


Conducting an acid-base titration using a Vernier Drop Counter, pH Sensor, and Stir Station



Monitoring mass in a HCl-Mg reaction

Investigating household acids and bases with Go Wireless pH



Acid-base titration with Go Wireless pH

a. NEW Go Wireless® pH, ORDER CODE GW-PH, $99

Transform the way your students collect data and explore scientific principles with Go Wireless pH. Students can easily analyze pH data in an engaging, hands-on way using the free Go Wireless app. View live readings from the wireless sensor, capture data in real time, and examine the results all from iPad®, iPhone®, or iPod touch®. Bluetooth® Smart Ready technology allows Go Wireless pH to be compatible with LabQuest 2 (model LQ2-LE). Go Wireless pH includes a USB charging cable and free sample labs, modified for Go Wireless pH, available on our website at **www.vernier.com/gw-ph**

With Go Wireless pH, students can investigate

- pH of household acids and bases
- Acid-base titrations
- Water quality … and much more!

b. NEW Go Wireless Electrode Amplifier

ORDER CODE **GW-EA, $79**

The Go Wireless Electrode Amplifier uses a standard BNC connector allowing removable electrodes to be connected for data collection. Vernier electrodes with a BNC connector include an ORP electrode and pH electrodes. Third-party electrodes may also be compatible.

c. BNC Electrodes

Vernier offers four electrodes using a BNC connector. These removable electrodes are compatible with Go Wireless Electrode Amplifier.

NEW Go Wireless pH Electrode	ORDER CODE **GW-PH-BNC, $40**
pH Electrode*	ORDER CODE **PH-BNC, $41**
Tris-Compatible Flat pH Electrode*	ORDER CODE **FPH-BNC, $64**
ORP Electrode*	ORDER CODE **ORP-BNC, $39**

* Electrodes are also compatible with Electrode Amplifier (EA-BTA).

a NEW $99

b NEW $79

c

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

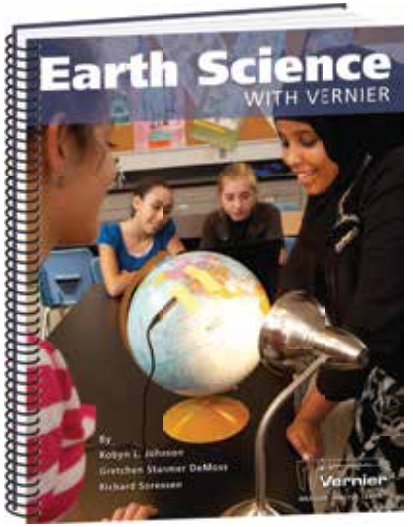
Our Deluxe Package contains all the sensors needed to perform every experiment in our Earth Science lab book.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide



EARTH SCIENCE LAB BOOK

$48 ORDER CODE **ESV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive

- Essential teacher information
- 33 ready-to-use student versions of Logger *Pro* experiments in print. LabQuest, computer, and calculator versions on CD
- A generous site license—buy one book and duplicate labs for your class
- Editable labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/esv**

Earth Science with Vernier lab book contains the following experiments:

USING A TEMPERATURE PROBE
- Introduction to Data Collection
- Soil Temperature
- Water Quality—Temperature
- Freezing of Ocean Water
- ▶ Reflection and Absorption of Light
- The Greenhouse Effect
- Land and Sea Breezes
- Relative Humidity
- Dew Point
- Wind Chill
- Seasons and Angle of Insolation
- Fossil Fuels
- Solar Homes

USING A LIGHT SENSOR
- ▶ Reflection and Absorption of Light
- Photovoltaic Cells

USING A pH SENSOR
- Soil pH
- Soil and Acid Rain
- Water Quality—pH
- Water Treatment
- Acid Rain and Its Effect on Surface Water

USING A MOTION DETECTOR
- Mapping the Ocean Floor

USING A UVB SENSOR
- Are All Sunglasses Created Equal?
- ▶ Comparing Sunscreens
- UV Light and Clothing

USING A CONDUCTIVITY PROBE
- Soil Salinity
- Water Quality—Total Dissolved Solids
- Water Treatment
- Salinity of Ocean Water
- Desalination

USING A TURBIDITY SENSOR
- Water Quality—Turbidity
- Water Treatment

USING A MAGNETIC FIELD SENSOR
- Exploring Magnetism
- Where IS North?
- Searching for Iron Ore
- Sea Floor Spreading

USING CURRENT AND VOLTAGE PROBES
- Photovoltaic Cells
- Wind Power

STARTER PACKAGES DELUXE PACKAGES ▶ VIDEO ONLINE

Look for training videos of some of these labs at **www.vernier.com/videos**

Earth Science LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-ES-ST	Deluxe Package LQ2-ES-DX
LabQuest 2 Interface	**LABQ2**	$329	$329
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
Light Sensor	LS-BTA	$55	$55
pH Sensor	PH-BTA	$79	$79
UVB Sensor	UVB-BTA	$107	$107
Magnetic Field Sensor	MG-BTA		$58
Conductivity Probe	CON-BTA		$95
Voltage Probe	VP-BTA		$12
Current Probe	DCP-BTA		$39
Turbidity Sensor	TRB-BTA		$112
Motion Detector	MD-BTD		$79
PACKAGE PRICE		**$628**	**$1,023**

YOU MAY ALSO NEED:

Earth Science with Vernier **lab book,** ORDER CODE **ESV, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

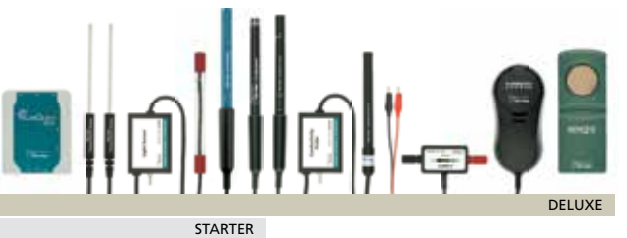
LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79.** See page 23.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $992 EACH AND **SAVE $248!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-ES-ST	Deluxe Package LM-ES-DX
LabQuest Mini Interface	**LQ-MINI**	$149	$149
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
Light Sensor	LS-BTA	$55	$55
pH Sensor	PH-BTA	$79	$79
UVB Sensor	UVB-BTA	$107	$107
Magnetic Field Sensor	MG-BTA		$58
Conductivity Probe	CON-BTA		$95
Voltage Probe	VP-BTA		$12
Current Probe	DCP-BTA		$39
Turbidity Sensor	TRB-BTA		$112
Motion Detector	MD-BTD		$79
PACKAGE PRICE		**$448**	**$843**



YOU MAY ALSO NEED:

Earth Science with Vernier **lab book,** ORDER CODE **ESV, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $818 EACH AND **SAVE $200!**

Davis® Weather Stations

Because they are accurate, economical, easy to use, and well built, Davis Weather Stations are a perfect choice for your school. The Davis Vantage Vue weather station is rugged, accurate, reliable, and very affordable. If you want customizable, professional units, the Vantage Pro2 and Vantage Pro2 Plus are excellent choices. All versions are wireless.

For further information about Davis Weather Station products, including computer software and hardware mounting options, see **www.vernier.com/weather**

$395 a

$595 b

a. Vantage Vue™, ORDER CODE DWVUE, $395

The Vantage Vue weather station includes a console with AC power adapter and a self-contained, easy-to-install sensor system. The console displays current data along with the ability to view graphs. All without a computer!

The integrated sensor suite combines a rain collector, temperature sensor, humidity sensor, wind direction and anemometer in one package. Vantage Vue provides all of the following:

- Barometric pressure
- Rain rate
- Inside and outside humidity
- Rainfall totals
- Inside and outside temperature
- Wind chill
- Wind speed and direction
- Heat index
- Dew point
- Moon phase
- Local forecast
- Time of sunrise and sunset at your location
- Highs and lows for most weather variables

b. Vantage Pro2™, ORDER CODE DWVP, $595

The Vantage Pro2 includes all of the features of Vantage Vue, however, you can add professional features such as a fan-aspirated radiation shield and other sensors.

Vantage Pro2 Plus™, ORDER CODE DWPLUS, $995

The Vantage Pro2 Plus includes all of the features of Vantage Pro2, plus a UV sensor, solar radiation sensor, and a sensor mounting shelf.

ADDITIONAL CONSOLE/RECEIVERS

By purchasing additional Console/Receivers, you can set up multiple monitoring stations in other classrooms throughout your school.

Davis Vantage Vue Console/Receiver
ORDER CODE **DWVUE-CR, $195**
For use with Vantage Vue

Davis Vantage Pro2 Console/Receiver
ORDER CODE **DCR, $295**
For use with Vantage Pro2 and Vantage Pro2 Plus

Davis WeatherLinkIP

Davis WeatherLinkIP, ORDER CODE **DWLINK-IP, $295**

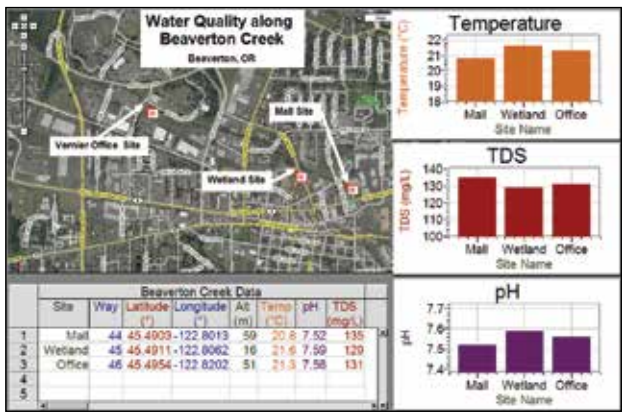
Post Davis Weather Station data directly to the Internet using the Davis WeatherLinkIP™. Simply plug the data logger into the back of your console and connect the cable to your cable/DSL router. Within minutes, you'll be able to see your weather data live on the Internet.

- View data on your internet-connected computer, tablet, or smart phone.
- Easily upload data to third-party weather sites such as Weather Underground or Citizen Weather Observer Program (CWOP).
- Get email alerts for current weather or alarm conditions.

Weather at the Vernier office using WeatherLinkIP

All Davis products carry a one-year warranty.

Tag data with GPS data points using LabQuest 2



Logger Pro combines GPS data and water quality sensor data

a. Anemometer, ORDER CODE **ANM-BTA, $89**

The Vernier Anemometer is an impeller-type anemometer that measures wind speed in the range of 0.5 to 30 m/s (1 to 67 mph). The Anemometer fits in your palm for wind study measurements in the field. A standard camera mount on the back and an accessory rod allows you to position it in wind tunnels or in front of fans for wind turbine experiments.

b. Magnetic Field Sensor, ORDER CODE **MG-BTA, $58**

Study the magnetic field surrounding various types of magnets.

c. UVA and UVB Sensors

ORDER CODE **UVA-BTA, $106, UVB-BTA, $107**

The UVA Sensor is an ultraviolet light sensor that responds primarily to UVA radiation (approximately 320 to 390 nm). This sensor is ideal for experiments using UV lamps.

The UVB Sensor is an ultraviolet light sensor that responds primarily to UVB radiation (approximately 290 to 320 nm). It is ideal for experiments using sunlight as your UV source.

d. Pyranometer, ORDER CODE **PYR-BTA, $199**

The Pyranometer measures the power of electromagnetic radiation. It is sensitive to near infrared, visible, and UV radiation, where 90% of solar energy is concentrated. It reads in watts per square meter, so it is great for experiments with solar cells and calculating their efficiency.

e. Surface Temperature Sensor, ORDER CODE **STS-BTA, $23**

The Surface Temperature Sensor is designed for use in situations in which low thermal mass or flexibility is required, or use it for skin temperature measurement.

Did you know?

The built-in GPS in LabQuest 2 makes it easy to add location information to your field data. When finished, simply transfer the data to Logger *Pro* and then export to Google Maps™ or GIS software.

a $89

b $58

c

d $199

e $23

ENGINEERING

Logger *Pro* Engineering Solutions

NEW Vernier Structures & Materials Tester 71
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STEM extensions for existing Vernier science experiments 73
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Vernier Products and Curriculum for LEGO®

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Applying engineering design processes to evaluate structure failure and improve design

Vernier Structures & Materials Tester

$999*
ORDER CODE
VSMT

NEW Bridge Testing and More

The Vernier Structures & Materials Tester (VSMT) is the perfect device for all project-based STEM and engineering classrooms. Use the VSMT, along with the engineering design method, to design, build, and test structures, conduct bridge competitions, and investigate and analyze beam designs and material properties.

The top support crossbars of the VSMT are designed to easily slide and lock into position. Ruled markings located on the VSMT allow you to accurately position the support beams for center or off-center loading.

The VSMT is equipped with a load cell and a displacement sensor. Using both sensors, maximum breaking loads, as well as load/displacement characteristics, can be recorded, enabling students to evaluate stress and strain. Use Logger *Pro* video analysis in conjunction with sensor measurements to see how and when things bend and break.

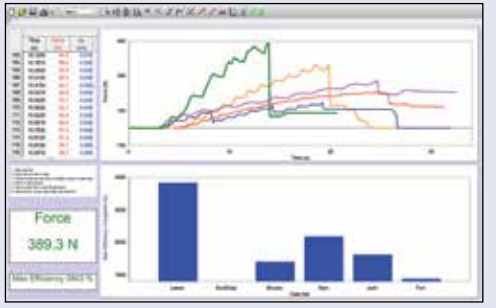
PRODUCT DETAILS

- Load cell: 0–1000 N
- Displacement sensor: 0.1 mm resolution
- Maximum travel: 7.5 cm
- Dimensions: 45 cm x 50 cm x 20 cm

WHAT'S INCLUDED

The VSMT ships with a well-outfitted VSMT Tackle Kit that includes two aluminum load plates (50 x 50 x 6 mm and 50 x 80 x 6 mm), a chain, rods, U-bolts, and other accessories to make it quick and easy to load bridges, materials, beams, and structures of varying sizes and shapes.

The VSMT Tackle Kit provides several options for attaching structures.



Several experiment files provide templates for common applications, such as a class bridge competition.

*Additional shipping charges may apply due to weight.

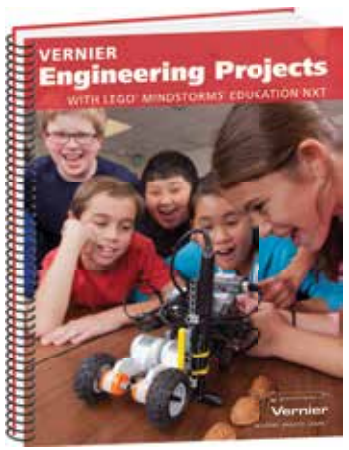
$39 (a)

a. NXT Sensor Adapter

ORDER CODE **BTA-NXT, $39**

The Vernier NXT Sensor Adapter allows certain Vernier sensors to work on the LEGO® MINDSTORMS® NXT and LEGO® MINDSTORMS® EV3 robotics system. Embedded in a LEGO® NXT sensor housing, the adapter is very easy to assemble on NXT and EV3 models. Enhance your robots and sensor-based control systems with sensors for measuring everything from temperature to force, light level, UV level, pH, and more.

$48 (b)



b. *Vernier Engineering Projects with LEGO® MINDSTORMS® Education NXT* lab book

ORDER CODE **EP-NXT, $48**

Vernier Engineering Projects with LEGO® MINDSTORMS® Education NXT contains 12 engineering challenges for use with the LEGO® MINDSTORMS® Education NXT Base Set and LEGO® MINDSTORMS® Education NXT Software version 2 (not compatible with EV3). This book is perfect to challenge upper middle school and high school students to build and program robots for testing batteries, to locate "land mines," to automate plant watering, and more. The sensors used in the challenges include Dual-Range Force Sensor, Magnetic Field Sensor, Voltage Probe, Gas Pressure, pH, Conductivity, UV, and Soil Moisture Sensor. (These challenges are a compilation from Vernier's original STEM and STEM2 books.)

A CD included with the book has editable student handouts, MINDSTORMS® NXT sample programs, movie clips, and LEGO® Digital Designer files. Buy one book and print out activities for your entire class.

A package is available that includes NXT adapters and all the sensors needed for the projects in this book. See **www.vernier.com/nxt-pkg**

EV3 ONLINE ACTIVITIES

The new LEGO® robotics system is the EV3. The Vernier NXT Sensor Adapter allows certain Vernier sensors to be used with the EV3 for exciting robotics projects with sensory feedback and control. See **www.vernier.com/lego-ev3**

Vernier Mars Challenge with LEGO® MINDSTORMS® Education EV3 online guide

This curriculum guide offers an opportunity to introduce young students to the physical concepts of electricity and magnetism through exciting hands-on robotics activities. By coupling robotics design with NASA's space program, students gain an understanding of scientific principles in a real-world application.

Students learn to use a Vernier Differential Voltage Probe and Magnetic Field Sensor as they build a solar tracker, a magnet detector, a battery tester, and a robotic compass. This guide was written for teachers with the Educator version of the LEGO® EV3 robotics system (not compatible with NXT). It is intended to be used for a week-long summer camp, a STEM classroom module, or an after-school club. Detailed descriptions of recommended activities are supplied for each unit, as well as optional extensions for early finishers. Sample programs and building guides are provided for all activities to aid teachers in their instruction. For more information, visit **www.vernier.com/mars-ev3**

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Turning on a "drinking fountain" based on position and velocity measurements from a motion detector

EASY STEPS FOR CONTROLLING DCU OUTPUT IN LOGGER *PRO*

1. Select the DCU line or lines you want to activate.
2. Build a logic statement to activate the line when this statement is true.
3. Choose AND, UNTIL, or OR to create a compound statement.

Creating a logic statement in Logger Pro *to turn on DCU line 1 when the position measurement is less than 0.5 meters AND the velocity measurement is greater than -0.1 meters/second*

Digital Control Unit

a. Digital Control Unit (DCU), ORDER CODE DCU-BTD, $61

Using a DCU with your standard Vernier sensors provides a perfect way to explore hands-on STEM and engineering projects or implement Next Generation Science Standards (NGSS) in the classroom. It provides the ability to take input from our sensors and use them to control output devices such as motors, buzzers, pumps, and LEDs with your Logger *Pro* software. This is a great entry point for programming and engineering design.

The DCU's connector provides two easy ways to connect your electrical device: connect the device to the DCU header pins or screw the electrical device's wires into the DCU's detachable screw terminal. The DCU connects to the digital port of any Vernier interface.

Once the electrical device is attached to the DCU, an external power supply, such as the LabQuest or LabPro power supply (not included, LQ-PS, $11, or IPS, $12), is required to power the device.

The DCU can also be controlled using National Instruments LabVIEW for Education software. In addition, the DCU can be connected to an Arduino™ or NI myDAQ (see page 75).

b. DCU Terminal Plug Kit, ORDER CODE DCU-PLUG, $39

The screw terminal plug connector is a detachable wiring plug for your DCU. The DCU is shipped with one plug, but it may be useful to have extras. Store your favorite projects with the electronics wired to their own plug and save time by not having to rewire them. In addition, you may want your students to be able to work on individual projects and share a DCU. Simply connect the plug when it is time to test or present each project. This kit includes four detachable plug connectors and one precision screwdriver that works with the small screws of the terminal plug.

Did you know?

You can take an existing Vernier science lab experiment and easily extend it to incorporate STEM. Find free, online STEM projects at **www.vernier.com/engineering/stem**

a $61

b $39

About Project Lead The Way

Project Lead The Way (PLTW) is the nation's leading provider of K-12 STEM curriculum. Through world-class, activity-, project-, and problem-based curriculum designed for elementary, middle, and high school students, PLTW helps students develop the skills needed to succeed in our global economy.

PLTW delivers programs to over 6,500 schools in all 50 states and the District of Columbia. In addition, PLTW trained more than 6,000 teachers in 2014 using its high-quality professional development model.

Project Lead The Way and Vernier

Over the years, Vernier has developed a strong partnership with Project Lead The Way. We value their mission to prepare students for the global economy.

By providing a comprehensive curriculum package based on national standards, focusing on teacher training, and integrating Vernier technology, the PLTW programs are extremely valuable for schools integrating hands-on, project-based STEM.

Measuring EMG and muscle fatigue in the PLTW Biomedical Sciences Program

PLTW PROGRAMS

PLTW Gateway – *Middle School*

Middle school is the perfect time for students to explore and learn that there is more than one way to reach a solution. Through topics like robotics, flight and space, and DNA and crime scene analysis, PLTW Gateway students will find their natural curiosity and imagination engaged in creative problem solving. Using the same advanced software and tools as the world's leading companies, students see the application of science, technology, engineering, and math to their everyday lives.

PLTW Biomedical Science – *High School*

PLTW's Biomedical Science program allows students to play the roles of biomedical professionals as they investigate and study the concepts of human medicine, physiology, genetics, microbiology, and public health. Through hands-on projects, students learn content in the context of real-world cases. They examine the structures and interactions of human body systems and explore the prevention, diagnosis, and treatment of disease, all while working collaboratively to understand and design solutions to the most pressing health challenges of today and the future.

PLTW Engineering – *High School*

PLTW Engineering is more than just another high school engineering program. It is about applying science, technology, engineering, and math to solve complex, open-ended problems in a real-world context. Students focus on the process of defining and solving a problem, not on getting the "right" answer. They learn how to apply STEM knowledge, skills, and habits of mind to make the world a better place through innovation.

Exploring Arduino and BYOS

SparkFun RedBoard with Cable

$25 ORDER CODE **ARD-RED**

The SparkFun® RedBoard is a surface-mount board, which is pin-for-pin compatible with an R3 Arduino™ layout. The key difference between the RedBoard and most Arduino boards is that it uses a mini-B USB connector instead of a full-size type-B USB connector. The RedBoard operating voltage is 5 volts, which is required for use with most Vernier sensors. You can power the RedBoard either with the USB connector (included) or with a 7–15 V barrel jack power supply (not included).

Vernier Arduino Interface Shield

$25 ORDER CODE **BT-ARD**

The Vernier Arduino Interface Shield plugs directly on top of the Arduino and adds two BTA (analog) and two BTD (digital) sockets. This shield was developed to be used with the SparkFun Arduino RedBoard but will work with the Arduino Uno and other Uno equivalents like the Leonardo. It also works with the Intel® Galileo.

A full online guide and sample code are provided on the Vernier website. Use the guide to get started writing your own data-collection programs using over 80 Vernier sensors.
www.vernier.com/arduino

Vernier Analog Breadboard Cable

$10 ORDER CODE **BB-BTA**

The Breadboard Cable (Analog) provides an easy way for students to build their own sensor circuitry and input the signal into a Vernier interface for data acquisition.

BYOS projects are available at
www.vernier.com/engineering/stem/

a. Vernier myDAQ Adapter

ORDER CODE **BT-MDAQ, $59**

The Vernier myDAQ Adapter can be used to perform data acquisition with over 60 Vernier sensors and the NI myDAQ interface. In addition to connecting Vernier sensors, the adapter provides access to two myDAQ analog output terminals and three digital terminals (including the frequency and pulse width modulation [PWM] outputs).

---

b. SensorDAQ, ORDER CODE SDAQ, $189

Designed by NI & Vernier for Engineering Education

SensorDAQ is perfect for teaching NI LabVIEW or for building sensor-controlled student projects using NI LabVIEW software.

- Compatible with 71 Vernier analog and digital sensors. Go to **www.vernier.com/sdaq**
- Use with NI LabVIEW software version 2009 or newer (not included)
- Windows only

Not compatible with Logger Pro *or Logger Lite software*

SensorDAQ carries a one-year warranty. Includes: SensorDAQ, Voltage Probe, USB cable, user manual, and sample programs

---

c. Analog Proto-Board Connector

ORDER CODE **BTA-ELV, $10**

Digital Proto-Board Connector

ORDER CODE **BTD-ELV, $10**

Use these adapters to connect Vernier sensors to a non-Vernier interface. The connector fits into a standard prototyping board or National Instruments' ELVIS prototyping board, providing easy access to the sensor lines.

a $59

b $189

c $10

NATIONAL INSTRUMENTS LABVIEW™ FOR EDUCATION SOFTWARE

Graphical Programming Language for High School STEM Education

The National Instruments LabVIEW for Education software helps teachers bring STEM concepts to life through hands-on learning. This is industry-standard LabVIEW (used throughout the engineering disciplines) refined for classroom use, with modules for educational hardware, including these Vernier products:

- LabQuest/LabQuest 2
- LabQuest Mini
- SensorDAQ
- NXT Sensor Adapter
- Go! devices (Go!Link, Go!Temp, Go!Motion)

Full integration means that everything required for these Vernier products is included. Install NI LabVIEW for Education, connect the Vernier hardware, and begin running examples to

- Log and analyze data
- Introduce engineering measurement and automation concepts
- Build sensor-controlled NXT robots
- Perform feedback and control
- Introduce biomedical concepts with physiology sensors

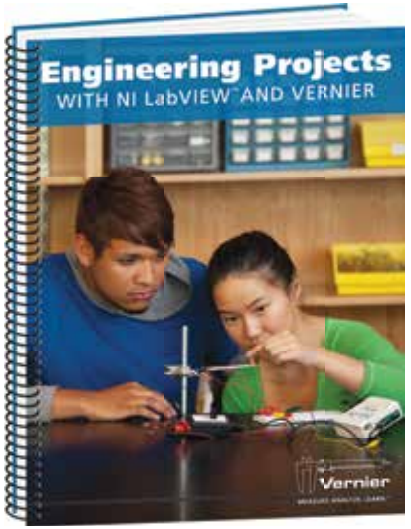
Single-User NI LabVIEW for Education
ORDER CODE **LV4E-1, $129**

10-User NI LabVIEW for Education
ORDER CODE **LV4E-10, $799**

LabVIEW for Education Site License
ORDER CODE **LV4E-SITE, $1,499**

Windows and Mac versions are included. For more information, go to **www.vernier.com/labview**

License available to U.S. high schools only. NI LabVIEW for use outside the U.S., in colleges and universities, or for individual use, should be purchased from National Instruments at **ni.com/academic**



ENGINEERING PROJECTS BOOK

$48 ORDER CODE **EPV** GREAT VALUE!

This lab book contains engaging hands-on projects for SensorDAQ, LabQuest, LabQuest 2, or LabQuest Mini. It introduces engineering concepts and programming with NI LabVIEW development software. An introductory knowledge of NI LabVIEW programming is assumed (see our *Hands-On Introduction to NI LabVIEW* book). When you buy the lab book, you will receive

- Essential teacher information
- 12 projects with challenge exercises
- A generous site license—buy one book and duplicate labs for your class
- Editable labs to meet your personal teaching style using Microsoft® Word® files for all experiments and teacher files on CD
- NI LabVIEW sample programs on CD for each project and challenge

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/epv**

Engineering Projects with NI LabVIEW and Vernier contains the following projects:

- Build a Temperature Sensor
- Digital Control Systems
- 3-Color LED
- Hot Wire Anemometer
- DC Motor Control
- Light Intensity
- Servo Motor
- EKG
- Blood Pressure
- Strain Gage Measurement
- Propeller Control
- Ping-Pong Ball Levitation

☐ STARTER PACKAGES ■ DELUXE PACKAGES

A GREAT WAY TO TEACH STEM

This book introduces many important science and engineering concepts, including analog and digital input, sensors and how they are calibrated, feedback and control, analog and digital output, servo and stepper motors, PID control, pulse-width modulation, voltage dividers, and Wheatstone bridges.

Videos of many of these projects are available at **www.vernier.com/epv-videos**

Engineering NI LabVIEW Packages

Purchase one package per lab group (2–4 students).

SensorDAQ	SENSORDAQ AND SENSORS	CODE	Intro to NI LabVIEW Package **SD-EE**	Engineering Projects with NI LabVIEW Starter **SD-EP-ST**	Engineering Projects with NI LabVIEW Deluxe **SD-EP-DX**
	Microphone	MCA-BTA	$39	—	—
	Stainless Steel Temperature Probe	TMP-BTA	$29	—	—
	SensorDAQ	**SDAQ**	**$189**	**$189**	**$189**
	Surface Temperature Sensor	STS-BTA		$23	$23
	Digital Control Unit	DCU-BTD		$61	$61
	Breadboard Cable	BB-BTA		$10	$10
	Instrumentation Amplifier	INA-BTA		$69	$69
	Light Sensor	LS-BTA		$55	$55
	EKG Sensor	EKG-BTA		$147	$147
	Analog Proto Board Connector	BTA-ELV			$10
	Digital Proto Board Connector	BTD-ELV			$10
	Power Amplifier	PAMP			$199
	Blood Pressure Sensor	BPS-BTA			$105
	Motion Detector	MD-BTD			$79
	Rotary Motion Sensor	RMV-BTD			$169
	Photogate	VPG-BTD			$45
	PACKAGE PRICE		**$257**	**$554**	**$1,171**
SPECIAL OFFER:	BUY 8 OR MORE PACKAGES AT $249 EACH AND SAVE **$64**				BUY 8 OR MORE DELUXE PACKAGES AT $1,136 EACH AND SAVE **$280**

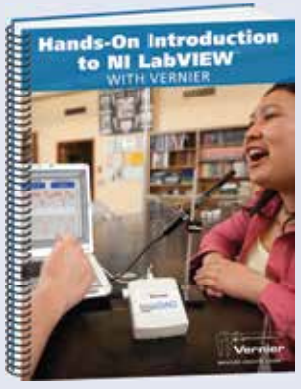
YOU MAY ALSO NEED:

LabVIEW for Education Software (one per seat)
ORDER CODE **LV4E-1, $129** (single user), or
ORDER CODE **LV4E-10, $799** (10 users), or
ORDER CODE **LV4E-SITE, $1,499** (site license)

One or both engineering lab books:

Hands-On Introduction to NI LabVIEW™ with Vernier
ORDER CODE **LWV, $25**

Engineering Projects with NI LabVIEW™ and Vernier
ORDER CODE **EPV, $48**



HANDS-ON INTRODUCTION TO NI LABVIEW™ WITH VERNIER LAB BOOK

ORDER CODE **LWV, $25**

This book introduces NI LabVIEW programming through a series of hands-on exercises using Vernier sensors and SensorDAQ, LabQuest, LabQuest 2, or LabQuest Mini. All of these chapters can be completed with the SD-EE package. Contents include

Getting Started
- Exercise 1 – Open and Run a LabVIEW Example VI

NI LabVIEW Environment
- Exercise 2 – Read Microphone Data

NI LabVIEW Programming
- Exercise 3 – Read and Analyze Microphone Data

Working with Loops
- Exercise 4 – Continuous Read and Analyze Microphone Data

Presenting Results
- Exercise 5 – Read Temperature Data

Decision Making
- Exercise 6 – Above Threshold Warning of Temperature Data

SubVIs
- Exercise 7 – Create a Temperature Conversion SubVI

SensorDAQ Automation*
- Exercise 8 – Control Analog Out, Digital Out, and Pulse Out

Projects
- Output a tone from your computer proportional to a sensor reading.
- Display which key is pressed on a cell phone by analyzing the frequency of the tone.

* Can only be done with SensorDAQ

1 IT ALL STARTS WITH CURRICULUM

Looking to introduce inquiry into your curriculum? Start with a Vernier lab book. Aligned to state and national science standards, our lab book contains environmental science inquiry investigations.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

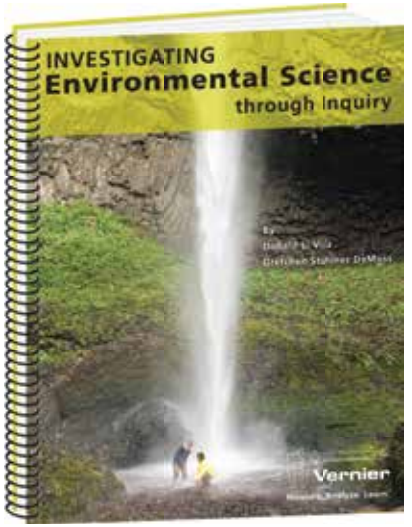
Our Deluxe Package contains all the sensors needed to perform every experiment in our environmental science lab book.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide



ENVIRONMENTAL SCIENCE LAB BOOK

$48 ORDER CODE **ESI** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive

- 34 inquiry-based, environmental science investigations
- Essential teacher information for successful inquiry investigations
- Suggested researchable questions, sample data, and graphs
- A generous site license. Buy one book and duplicate labs for your class
- Microsoft® Word® files on CD for the experiments so you can easily edit labs to meet your personal teaching style

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/esi**

Investigating Environmental Science through Inquiry lab book contains the following inquiry experiments:

USING A TEMPERATURE PROBE
- Seasons and Angle of Insolation
- A Local Weather Study
- Water Quality
- Long Term Water Monitoring
- Soil Temperature
- Biodiversity in Ecosystems
- Water Cycle Column Investigations
- Decomposition Column Investigations
- Ecocolumn Investigations
- Global Warming
- Insulation Study
- Fossil Fuel Energy
- Energy Conversion
- An Investigation of Passive Solar Heating
- A Pollution Study

USING A TURBIDITY SENSOR
- Water Quality
- Long Term Water Monitoring
- Water Treatment
- Population Dynamics
- A Pollution Study

USING A pH SENSOR
- Water Quality
- Long Term Water Monitoring
- Water Treatment
- Soil pH
- Soil and Acid Precipitation
- Water Cycle Column Investigations
- Decomposition Column Investigations
- The Effect of Acid Deposition on Aquatic Ecosystems
- A Pollution Study
- Ecocolumn Investigations

USING A CONDUCTIVITY SENSOR
- Water Quality
- Long Term Water Monitoring
- Water Treatment
- Investigating Salinity
- Soil Salinity
- Water Cycle Column Investigations
- Ecocolumn Investigations
- The Effect of Acid Deposition on Aquatic Ecosystems

USING A SOIL MOISTURE SENSOR
- Soil Moisture
- Managing Garden Soil Moisture
- Biodiversity in Ecosystems
- Water Cycle Column Investigations
- Ecocolumn Investigations
- A Pollution Study

USING A DISSOLVED OXYGEN PROBE
- Investigating Dissolved Oxygen
- Water Quality
- Long Term Water Monitoring
- Biochemical Oxygen Demand
- Primary Productivity
- A Pollution Study

USING A UV SENSOR
- A Local Weather Study
- UV Investigations
- ▶ Comparing Sunscreens

USING A VOLTAGE & CURRENT PROBE
- Wind Power
- Photovoltaic Cells

USING A RELATIVE HUMIDITY SENSOR
- A Local Weather Study
- Biodiversity in Ecosystems
- Water Cycle Column Investigations
- Decomposition Column Investigations
- Ecocolumn Investigations
- A Pollution Study

USING A LIGHT SENSOR
- Biodiversity in Ecosystems
- Water Cycle Column Investigations
- Decomposition Column Investigations
- Ecocolumn Investigations
- Measuring Particulates
- Energy Conversions

USING A CO_2 GAS SENSOR
- ▶ Cell Respiration
- Water Cycle Column Investigations
- Decomposition Column Investigations
- Investigating Indoor Carbon Dioxide Concentrations
- A Pollution Study
- Ecocolumn Investigations

STARTER PACKAGES DELUXE PACKAGES ▶ VIDEO ONLINE

Environmental Science LabQuest 2 Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-EV-OST	Deluxe Package LQ2-EV-ODX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
pH Sensor	PH-BTA	$79	$79
Conductivity Probe	CON-BTA	$95	$95
Vernier Optical DO Probe*	ODO-BTA	$389	$389
Soil Moisture Sensor	SMS-BTA	$95	$95
Turbidity Sensor	TRB-BTA	$112	$112
Relative Humidity Sensor	RH-BTA		$69
UVB Sensor	UVB-BTA		$107
CO_2 Gas Sensor	CO2-BTA		$249
Voltage Probe	VP-BTA		$12
Current Probe	DCP-BTA		$39
Light Sensor	LS-BTA		$55
PACKAGE PRICE		**$1,128**	**$1,659**

DELUXE

STARTER

YOU MAY ALSO NEED:

***Investigating Environmental Science through Inquiry* lab book,** ORDER CODE **ESI, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,609 EACH AND **SAVE $400!**

*Packages containing the Dissolved Oxygen Probe are available online.

VERNIER OPTICAL DO PROBE

ORDER CODE **ODO-BTA, $389**

Students can now measure the concentration of dissolved oxygen in water quickly and easily with the Vernier Optical DO Probe. This probe can be used to determine changes in dissolved oxygen levels, one of the primary indicators of the quality of an aquatic environment.

- Plug-and-play technology—no filling solution, warm-up time, calibration, or stirring necessary
- Built-in temperature and pressure compensation
- Easy maintenance
- Switch setting allows units of mg/L or % saturation
- Extended 2-year warranty on the ODO Cap
- Expanded range of 0–300% saturation

For more details see page 47.

Did you know?

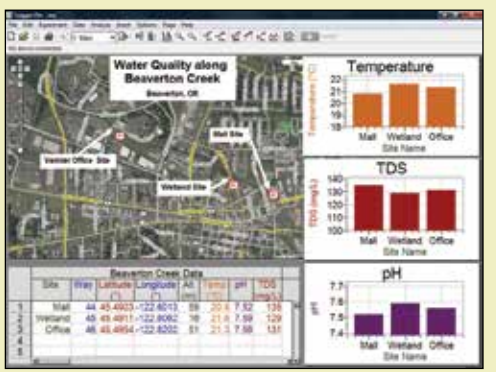
AP* Environmental Studies program and the IB† Environmental Systems and Societies programs both recommend a strong laboratory and field investigation component. The *Investigating Environmental Science through Inquiry* lab book includes experiments correlated to both AP and IB standards.

MORE ONLINE – For correlations of Vernier labs to AP/IB objectives, visit **www.vernier.com/environmental/**

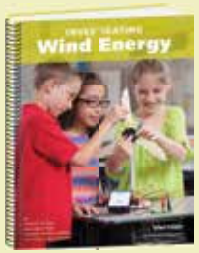
* AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.
† The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.

BUILT-IN GPS

The built-in GPS in LabQuest 2 makes it easy to add location information to your field data. When finished, simply transfer the data to Logger *Pro* and then export to Google Maps™ or GIS software.



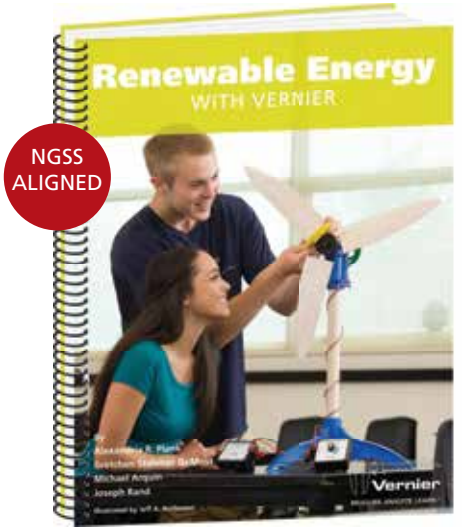
LOOKING FOR SOMETHING FOR ELEMENTARY RENEWABLE ENERGY EDUCATION?



NEW
***Investigating Wind Energy* lab book**

ORDER CODE
ELB-WIND, $25
See page 125.

Both renewable energy lab books were written for and are aligned with the Next Generation Science Standards (NGSS).



RENEWABLE ENERGY LAB BOOK

$48 ORDER CODE **REV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive

- EQuIP rubric friendly experiments—each shows connections to NGSS
- 26 experiments and engineering projects in wind and solar energy
- Essential teacher information for successful investigations
- A generous site license. Buy one book and duplicate labs for your class
- Microsoft® Word® files on CD for the experiments so you can easily edit labs to meet your personal teaching style

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/rev**

The *Renewable Energy with Vernier* lab book contains the following experiments and engineering projects:

EXPERIMENT	SENSORS USED	LAB EQUIPMENT USED
1 Renewable Energy: Why is it So Important?	Light Sensor	
2 What is Energy?	Surface Temperature Sensor	
3 Project: Energy Audit	Surface Temperature Sensor, Watts Up Pro	
4 Voltage and Circuits	Vernier Energy Sensor	Vernier Variable Load
5 Current and Resistors	Vernier Energy Sensor	
6 Mechanical Power	No sensor used	KidWind Advanced Wind Experiment Kit
7 Generators	Vernier Energy Sensor	KidWind simpleGEN
8 Exploring Wind Turbines	Vernier Energy Sensor	Vernier Variable Load, KidWind Advanced Wind Experiment Kit
9 Effect of Load on Wind Turbine Output	Vernier Energy Sensor	Vernier Variable Load, KidWind Advanced Wind Experiment Kit
10 Blade Variables and Power Output	Vernier Energy Sensor	Vernier Variable Load, KidWind Advanced Wind Experiment Kit
11 Solidity (computer only)	Vernier Energy Sensor	Vernier Variable Load, KidWind Advanced Wind Experiment Kit
12 Turbine Efficiency	Vernier Energy Sensor, Anemometer	Vernier Variable Load, KidWind Advanced Wind Experiment Kit
13 Power Curves	Vernier Energy Sensor, Anemometer	Vernier Variable Load, KidWind Advanced Wind Experiment Kit
14 Power and Energy	Vernier Energy Sensor	Vernier Variable Load, KidWind Advanced Wind Experiment Kit
15 Project: Maximum Energy Output	Vernier Energy Sensor	Vernier Variable Load, KidWind Advanced Wind Experiment Kit
16 Project: Build a Wind Farm	Vernier Energy Sensor	Vernier Variable Load, KidWind Advanced Wind Experiment Kit
17 Exploring Solar Panels	Vernier Energy Sensor	Vernier Variable Load, KidWind 2V/400mA Solar Panel
18 Effect of Load on Solar Panel Output	Vernier Energy Sensor	Vernier Variable Load, KidWind 2V/400mA Solar Panel
19 Variables Affecting Solar Panel Output	Vernier Energy Sensor, Light Sensor (optional)	Vernier Variable Load, KidWind 2V/400mA Solar Panel
20 Effect of Temperature on Solar Panel Output	Vernier Energy Sensor, Surface Temperature Sensor	Vernier Variable Load, KidWind 2V/400mA Solar Panel
21 Project: Build a Solar Charger	Vernier Energy Sensor	Vernier Variable Load, KidWind 2V/400mA Solar Panel
22 Exploring Passive Solar Heating	Surface Temperature Sensor	
23 Variables Affecting Passive Solar Heating	Surface Temperature Sensor (2)	
24 Exploring Solar Collectors	Surface Temperature Sensor, Light Sensor	KidWind Solar Thermal Exploration Kit
25 Variables Affecting Solar Collectors	Surface Temperature Sensor	KidWind Solar Thermal Exploration Kit
26 Project: Solar Cooker	Surface Temperature Sensor	

Products for Renewable Energy

LabQuest 2 or LabQuest Mini		CODE	LABQUEST 2	LABQUEST MINI
LabQuest 2 Connected Science System	**INTERFACE & SENSORS**			
	CHOOSE ONE — **LabQuest 2**	**LABQ2**	$329	—
Standalone, Computer, or Tablet	CHOOSE ONE — **LabQuest Mini (computer)**	**LQ-MINI**	—	$149
	Vernier Energy Sensor	VES-BTA	$69	$69
	Surface Temperature Sensor	STS-BTA	$23	$23
	Light Sensor	LS-BTA	$55	$55
	Anemometer	ANM-BTA	$89	$89
	LAB EQUIPMENT			
Computer Only	Vernier Variable Load	VES-VL	$59	$59
	KidWind Advanced Wind Experiment Kit	KW-AWX	$139	$139
	KidWind 2V/400mA Solar Panel	KW-SP2V	$11	$11
	KidWind simpleGEN Kit	KW-SGEN	$35	$35
	KidWind Solar Thermal Exploration Kit	KW-STXK	$40	$40
VOLUME DISCOUNTS	CALL US AT **888-837-6437** FOR A PRICE QUOTATION			

SOFTWARE:

Logger *Pro* 3 software, ORDER CODE **LP, $249**
See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

* We also recommend the Watts Up Pro, (WU-PRO, $145).

FEATURED PRODUCTS FOR RENEWABLE ENERGY EDUCATION

KidWind Advanced Wind Experiment Kit

ORDER CODE **KW-AWX, $139**

This kit is an integral part of our new lab book, *Renewable Energy with Vernier*. Discover advanced concepts of wind turbine technology, including gearboxes and generators. Students can use the blades they design to generate electricity, lift weights, and pump water.

Vernier Energy Sensor

ORDER CODE **VES-BTA, $69**

Used in 17 experiments in the *Renewable Energy with Vernier* lab book, the Vernier Energy Sensor offers an easy way to quantify voltage, current, power, and energy output of small wind turbines and solar panels. Simply connect a source, such as a small wind turbine or solar panel, and a load, such as the Vernier Resistor Board or Variable Load.

KidWind simpleGEN

ORDER CODE **KW-SGEN, $35**

The simpleGEN is an easy-to-build AC generator for exploring the basics of electrical generator design. Demonstrate Faraday's law, light LEDs, and perform experiments that explore how coils, magnets, and rotation affect power generation.

KidWind by Vernier

Kidwind Project—Teaching the World About Wind

KidWind and Vernier have teamed up to bring you the latest in renewable energy education. For over a decade, KidWind has been a leader in renewable energy education and the delivery of STEM education. Their standards-based educational tools explore the science and technology of wind, solar, and other forms of renewable energy and their impact on the environment.

Through KidWind's extensive training network, teacher trainings, and student wind turbine design competitions, KidWind brings hands-on applications of their materials to teachers and students worldwide.

Collecting wind power data from a KidWind wind turbine

KIDWIND AND VERNIER

Vernier technology is used at KidWind trainings and KidWind Challenges. It allows participants to explore electrical concepts and quantify energy and power of small wind turbines and solar panels.

For more information on KidWind, visit **learn.kidwind.org**

DATA COLLECTION WITH KIDWIND AND VERNIER

KidWind and Vernier offer a perfect solution for data collection for renewable energy and the Science and Engineering Practices for Next Generation Science Standards.

- Start by choosing the Vernier lab book that fits your curriculum from the list below.
- Next, choose the interface best situated to your classroom environment. See page 16 for interface details.
- Select your sensors from Vernier's recommendations on page 81 and 84 or build your own package from our list of sensors.

CURRICULUM

Renewable energy experts from KidWind and Vernier have developed experiments for you to use in your classroom.

NEW ***Renewable Energy with Vernier*** **lab book**, suitable for grades 7–12
ORDER CODE **REV, $48.** See page 80.

NEW ***Investigating Wind Energy*** **lab book**, suitable for grades 4–6
ORDER CODE **ELB-WIND, $25.** See page 125.

Measuring power produced by a solar panel

a. Vernier Energy Sensor, ORDER CODE VES-BTA, $69

The Vernier Energy Sensor offers an easy way to quantify voltage, current, power, and energy output of small wind turbines and solar panels. To use with a KidWind Wind or Solar Experiment Kit, simply connect a small wind turbine or solar panel to one side as a source and a Vernier Resistor Board or Vernier Variable Load to the other side as a load. The Energy Sensor measures the current and voltage of the system. Logger *Pro* or LabQuest App data-collection and analysis software then calculates the power and energy output.

---

b. Vernier Variable Load, ORDER CODE VES-VL, $59

The Vernier Variable Load is used in conjunction with the Vernier Energy Sensor to provide a range of resistive loads for projects with wind turbines or solar panels. This load is used in our *Renewable Energy with Vernier* lab book.

---

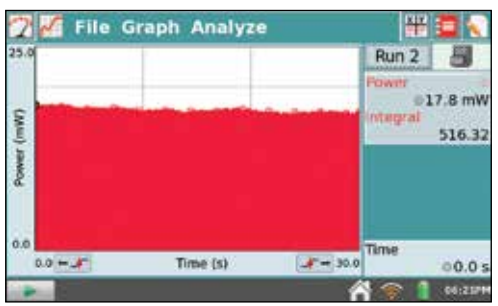
c. Vernier Resistor Board, ORDER CODE VES-RB, $18

The Vernier Resistor Board provides a small set of load resistors for KidWind wind turbines and solar panels. This board is used in our *Investigating Wind Energy* lab book.

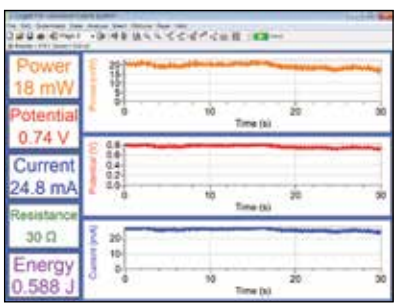
a $69

b $59

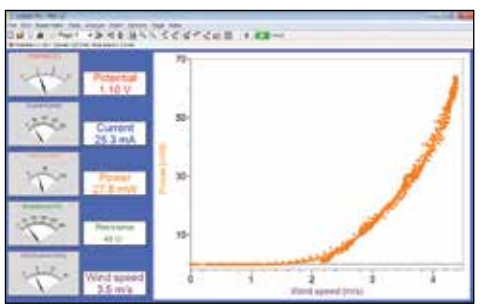
c $18



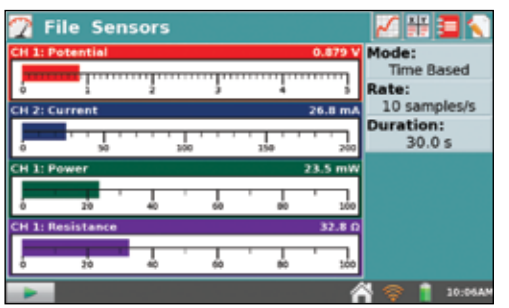
Measuring energy produced over 30 seconds by a student wind turbine



Logger Pro *used to graph potential, current, and power* vs. *time*



Power produced by a wind turbine as a function of wind speed



When the Energy Sensor is connected to LabQuest 2, four meters are displayed automatically.

a. KidWind Advanced Wind Experiment Kit

ORDER CODE **KW-AWX, $139***

Discover advanced concepts of wind turbine technology, including gearboxes and generator construction (with the simpleGEN add-on). Students can use the blades they design to generate electricity, lift weights, and pump water. This kit is recommended for use with our new book, *Renewable Energy with Vernier.*

KidWind Advanced Wind Experiment Kit Classroom Pack

ORDER CODE **KW-AWXC, $363***

The classroom pack option includes three turbine towers and bases, three nacelles, three generator sets, eight hubs, and blade consumables for eight groups of 2 to 4 students.

b. KidWind Basic Wind Experiment Kit

ORDER CODE **KW-BWX, $99***

Explore wind energy affordably and easily. This kit, one of our most popular, allows young scientists to test a variety of blade designs, generate electricity (0.5–3 V range), and lift weights. The Basic Wind Experiment Kit has all the materials you need to get started with wind power. Great for classrooms, as well as individual science fair projects.

KidWind Basic Wind Experiment Kit Classroom Pack

ORDER CODE **KW-BWXC, $285***

The classroom pack option includes three turbine towers and bases, three nacelles, three generators, eight hubs, and blade consumables for eight groups of 2 to 4 students.

*Additional shipping charges may apply due to weight.

RECOMMENDED CLASSROOM SETUP

We recommend three setups for a classroom with 6 to 10 groups of 2 to 4 students. Each setup should have a box fan, a wind turbine tower and base, a Vernier interface, a Vernier Energy Sensor (VES-BTA), and either a Vernier Variable Load (VES-VL) or a Vernier Resistor Board (VES-RB). Each group needs a Blade Pitch Protractor, a Wind Turbine Hub, and blade consumables.

WHICH KIDWIND KIT SHOULD I BUY?

I Teach:	I Should Buy:
K–3	MINI Wind Turbine
4–5	MINI Wind Turbine with Blade Design
6–8	Basic Wind Experiment Kit
High School	Advanced Wind Experiment Kit
University	Advanced Wind Experiment Kit with GenPack or simpleGEN Add-on
I Want to:	**I Should Buy:**
Lift weight	Basic Wind Experiment Kit
	Advanced Wind Experiment Kit
Light an LED	MINI Wind Turbine
	MINI Wind Turbine with Blade Design
	Basic Wind Experiment Kit
	Advanced Wind Experiment Kit
Make a sound	MINI Wind Turbine
	MINI Wind Turbine with Blade Design
Pump water	Advanced Wind Experiment Kit
Build a wind farm	Advanced Wind Experiment Kit
Use the *Renewable Energy with Vernier* lab book	Advanced Wind Experiment Kit
Use the *Investigating Wind Energy* lab book	MINI Wind Turbine with Blade Design

Students investigate wind energy

KIDWIND ACCESSORIES, CONSUMABLES, AND REPLACEMENT PARTS

PART NAME	CODE	PRICE
Basic Turbine Building Parts	KW-BTPART	$12
Basic Turbine Building Parts 10 Pack	KW-BTPART10	$109
Wind Turbine Hub 3 Pack	KW-WTH3	$20
Wind Turbine Hub 10 Pack	KW-WTH10	$66
Blade Design Consumables Classroom Pack	KW-BDC	$109
Dowels – 25 Pack	KW-D25	$4
Dowels – 100 Pack	KW-D100	$9
Wind Turbine Generator	KW-GEN	$5
Blade Pitch Protractor	KW-BPP	$4

Engineering blade design

a. KidWind MINI Wind Turbine, ORDER CODE KW-MWT, $38

Demonstrate the power of the wind with an affordable and rugged wind turbine. This is an easy-to-build turbine that will light an LED bulb and play a tune on the included Sound and Light Board. The highly efficient blades produce plenty of power.

b. KidWind MINI Wind Turbine with Blade Design

ORDER CODE KW-MWTBD, $49

The MINI Wind Turbine with Blade Design allows students to perform basic blade experiments on a desk using a small house fan. This kit is recommended for use with our new book, *Investigating Wind Energy*.

TURBINE PARTS

c. Basic Turbine Building Parts, ORDER CODE KW-BTPART, $12

The Basic Turbine Building Parts kit includes the Wind Turbine Hub, a Wind Turbine Generator, and 25 Dowels, all in one package.

These are the bare-bones components to build your own experimental wind turbine. This package is great for students who do not want a ready-made wind turbine tower and base, and for educators who want an affordable way for each of their students (or student groups) to do hands-on experiments with wind power.

d. KidWind simpleGEN, ORDER CODE KW-SGEN, $35

The simpleGEN is an easy-to-build AC generator for exploring the basics of electrical generator design. Demonstrate Faraday's law, light LEDs, and perform experiments that explore how coils, magnets, and rotation affect power generation. Convert your generator to a simple motor and explore additional variables. Take your experiments to the next level by converting your simpleGEN into a wind turbine nacelle.

KidWind simpleGEN Classroom Pack

ORDER CODE KW-SGENC, $299

The simpleGEN Classroom Pack has enough materials to build 10 generators.

For information on complete kit contents and additional KidWind parts and accessories visit **www.vernier.com/kidwind**

a $38

b $49

c $12

d $35

$40 a

$49 b

$11 c

$72 d

$199 e

a. KidWind Solar Thermal Exploration Kit
ORDER CODE **KW-STXK, $40**

The Solar Thermal Exploration Kit is modeled after a domestic solar water-heating system. Explore variables such as box color, light intensity, tube design, and rate of water pumping. Learn about what makes a solar water heating system more or less efficient.

b. KidWind Sun Angle Science Kit
ORDER CODE **KW-SASK, $49**

Discover how the angle of photovoltaic panels relative to the sun affects power output. Experiment with basic circuits and learn about important factors in photovoltaic systems.

c. 2V/400mA Solar Panel
ORDER CODE **KW-SP2V, $11**

This high-quality solar panel is great for demonstrations and experiments. External screw terminals and attached clip cords make the panels easy to use.

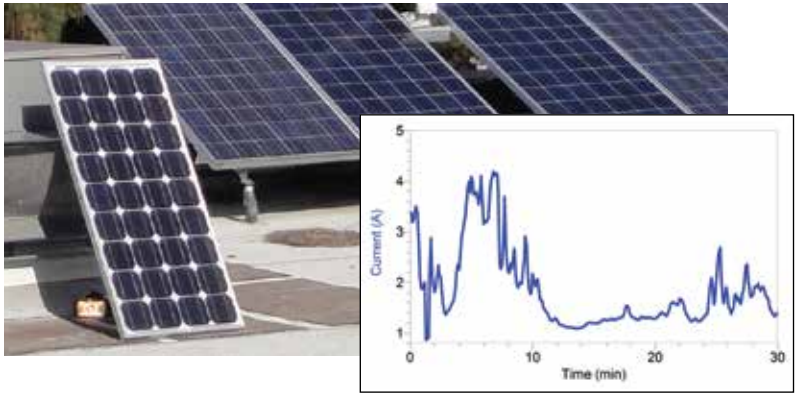
d. 12V/500mA Solar Panel
ORDER CODE **KW-SP12V, $72**

The powerful 12V/500mA (6 watt) Solar Panel is great for classroom experiments and basic applications that require more power. Suitable for long-term, outdoor use, this panel can function as a power source for many devices. You can quickly connect electrical devices and circuits with large clamps on 20-inch wire.

Please note: The 12 V panel is not recommended for use with small load devices, such as small motors, water pumps, sound and light boards, or LEDs. When applying power to an electrical device, verify the max power input to avoid damaging the device.

e. Pyranometer, ORDER CODE **PYR-BTA, $199**

The Pyranometer measures the power of electromagnetic radiation. It is sensitive to near infrared, visible, and UV radiation, where 90% of solar energy is concentrated. It reads in watts per square meter, so it is great for experiments with solar cells and calculating their efficiency.



Current draw from large solar panel on partially cloudy day

HIGH CURRENT SENSOR

Do you do experiments with solar panels or other high-current devices? Our High Current Sensor can handle the higher currents from hand-crank generators, large batteries, and solar panels.

The Vernier High Current Sensor has a range of ±10 A (the Energy Sensor has a range of ±1 A). Current is measured with a Hall effect sensor, which uses the magnetic field created by the current. This means that a sense resistor is not required, reducing the effect of the sensor on your circuit. A magnetic shield keeps measurements undisturbed by external fields. There is a user-replaceable fuse inside to protect the sensor.

The graph shows the current from a solar panel, which requires the wider range of the High Current Sensor.

30-VOLT VOLTAGE PROBE

If you need only voltage measurements, we also have a 30-Volt Voltage Probe that's great for use with large solar panels such as the KidWind 12V/500mA Solar Panel.

$79 ORDER CODE **HCS-BTA**

$49 ORDER CODE **30V-BTA**

Experiment 10 from* Middle School Science with Vernier, *"What Causes the Seasons?"

K–8

Getting Started

How to Choose an Interface 16

Curriculum

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Elementary Science with Vernier 90
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NEW *Investigating Wind Energy* 92

Outfitting Your Lab

MIDDLE SCHOOL
LabQuest 2 Packages 89
• Standalone / Computer
Go!Link Computer Interface Packages 89
• Computer

ELEMENTARY
LabQuest 2 Package 91
• Standalone / Computer
Go!Link Computer Interface Packages 91
• Computer

FEATURED PRODUCTS

INTERFACE

• Vernier LabQuest 2 17–23
• Go!Link 26

SENSORS & ACCESSORIES

• Go!Motion 90
• Go!Temp 90
• Force Plate 90
• Magnetic Field Sensor 90

CONNECT WIRELESSLY TO YOUR TABLET

These high-quality, yet affordable, data-collection devices are changing the way middle school students collect scientific data during classroom investigations.

Go Wireless Link

Coming in 2015! Make many of our existing sensors "wireless" with our new Go Wireless Link. Perfect for use with tablets. See page 10 or **www.vernier.com/gw-link**

Go Wireless Temp

Ideal for young learners, this durable, easy-to-use stainless steel temperature probe is the perfect solution for tablet-based data collection. See page 11 or **www.vernier.com/gw-temp**

Go Wireless pH

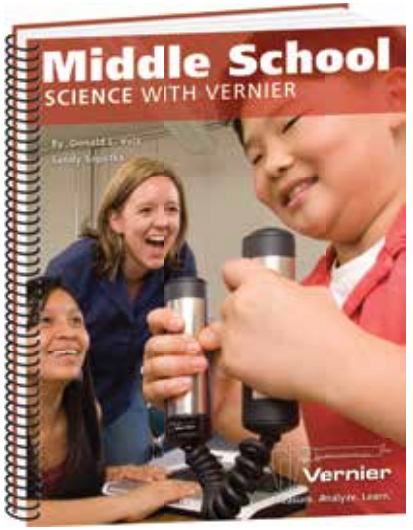
The Vernier Go Wireless pH is a general-purpose, wireless pH sensor you can use to remotely monitor pH. See page 12 or **www.vernier.com/gw-ph**

Go Wireless Heart Rate

Using our Go Wireless Heart Rate, students can continuously monitor heart rate before, during, and after exercise. A perfect solution for tablet-based data collection. See page 12 or **www.vernier.com/gw-hr**

NODE

NODE is a wireless sensor platform developed by Variable, Inc. It has several built-in sensors and supports a variety of interchangeable sensor modules. See page 13 or **www.vernier.com/node**



MIDDLE SCHOOL SCIENCE LAB BOOK

$48 ORDER CODE **MSV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive

- Essential teacher information
- 38 ready-to-use student versions of computer experiments in print; LabQuest, computer, and calculator versions on CD
- A generous site license—buy one book and duplicate labs for your class
- Microsoft® Word® files for all versions of the experiments on CD so you can easily edit labs to meet your personal teaching style
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/msv**

Middle School Science with Vernier lab book contains the following experiments:

☐ ☐ **USING TEMPERATURE PROBES**
- A Hot Hand
- Heating of Land and Water
- The Greenhouse Effect
- Relative Humidity
- Absorption of Radiant Energy
- Schoolyard Study
- A Good Sock
- What Causes the Seasons?
- Solar Homes
- Boiling Temperature of Water
- Freezing Temperature of Water
- How Low Can You Go?
- A Good Cold Pack
- A Water Field Study
- Cooling Rates: Shaq *vs.* Susie

☐ ☐ **USING A pH SENSOR**
- Soil Study
- A Water Field Study

☐ ☐ **USING A VOLTAGE PROBE**
- Lemon "Juice"

☐ ☐ **USING A MOTION DETECTOR**
- Ocean Floor Mapping
- Graphing Your Motion
- Velocity
- A Speedy Slide
- The Indy 100
- Crash Dummies
- Falling Objects

☐ ☐ **USING A LIGHT SENSOR**
- Reflectivity of Light
- Schoolyard Study

☐ ☐ **USING A FORCE SENSOR**
- Friction
- First-Class Levers
- Pulleys
- Buoyancy

☐ ☐ **USING A CONDUCTIVITY PROBE**
- Water Hardness Study
- Diffusion: How Fast?
- A Water Field Study

☐ ☐ **USING A GAS PRESSURE SENSOR**
- Get a Grip!
- Fun with Pressure
- Yeast Beasts in Action

☐ ☐ **USING A HAND-GRIP HEART RATE MONITOR**
- Heart Rate and Body Position
- Heart Rate and Exercise

☐ ☐ **USING A MAGNETIC FIELD SENSOR**
- Mapping a Magnetic Field
- Electromagnets

☐ STARTER PACKAGES ☐ DELUXE PACKAGES

Middle School Science LabQuest 2 and Go!Link Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-MS-ST	Deluxe Package LQ2-MS-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Motion Detector	MD-BTD	$79	$79
pH Sensor	PH-BTA	$79	$79
Voltage Probe	VP-BTA	$12	$12
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
Light Sensor	LS-BTA	$55	$55
Dual-Range Force Sensor	DFS-BTA		$109
Gas Pressure Sensor	GPS-BTA		$83
Hand-Grip Heart Rate Monitor	HGH-BTA		$119
Conductivity Probe	CON-BTA		$95
Magnetic Field Sensor	MG-BTA		$58
PACKAGE PRICE		**$612**	**$1,076**

YOU MAY ALSO NEED:

Middle School Science with Vernier **lab book**
ORDER CODE **MSV, $48**

Logger Lite software
Free download at **www.vernier.com/logger-lite**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,044 EACH AND **SAVE $256!**

Go!Link

USB Computer Interface

GO!LINK INTERFACE & SENSORS	CODE	Starter Package MSS-GO-STR	Deluxe Package MSS-GO-DX
Vernier Go!Link Interface	**GO-LINK**	$61	$61
Go!Motion	GO-MOT	$109	$109
pH Sensor	PH-BTA	$79	$79
Voltage Probe	VP-BTA	$12	$12
(2) Go!Temp	GO-TEMP	2 @ $39	2 @ $39
Light Sensor	LS-BTA	$55	$55
Dual-Range Force Sensor	DFS-BTA		$109
Gas Pressure Sensor	GPS-BTA		$83
Hand-Grip Heart Rate Monitor	HGH-BTA		$119
Conductivity Probe	CON-BTA		$95
Magnetic Field Sensor	MG-BTA		$58
PACKAGE PRICE		**$394**	**$858**

YOU MAY ALSO NEED:

Middle School Science with Vernier **lab book**
ORDER CODE **MSV, $48**

Logger Lite software
Free download at **www.vernier.com/logger-lite**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $832 EACH AND **SAVE $208!**

MORE ONLINE – For additional middle school package options, visit www.vernier.com/middle-school

Go!Temp
ORDER CODE **GO-TEMP, $39**

Connect directly to the USB port on your computer to collect temperature data. For more details, see page 27.

Let's Go! Investigating Temperature lab book
ORDER CODE **ELB-TEMP, $25**

A collection of 10 temperature experiments for computer or LabQuest. These labs are also included in the *Elementary Science with Vernier* book.

Magnetic Field Sensor
ORDER CODE **MG-BTA, $58**

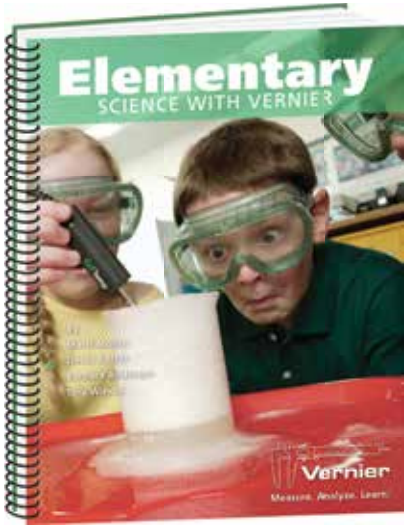
Study the magnetic field surrounding various types of magnets.

Force Plate
ORDER CODE **FP-BTA, $245**

The Force Plate is a large force sensor—tough enough to jump on. Two handles are included for pushing or pulling. For more details, see page 146.

Go!Motion
ORDER CODE **GO-MOT, $109**

Connect directly to the USB port on your computer to collect position, velocity, and acceleration data. For more details, see page 27.



ELEMENTARY SCIENCE LAB BOOK

$48 ORDER CODE **EWV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive

- Essential teacher information
- 43 ready-to-use student versions of Logger Lite experiments and one project in print; LabQuest and computer versions on CD
- A generous site license—buy one book and duplicate labs for your class
- Microsoft® Word® files on CD for the experiments so you can easily edit labs to meet your personal teaching style
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/ewv**

Elementary Science with Vernier lab book contains the following experiments:

USING A TEMPERATURE PROBE
- Learning to Use Go!Temp
- How do Mittens Keep You Warm?
- Baggie Mittens
- The Sole Purpose
- Cool Reaction!
- Cold as Ice
- Are We Cool or What?
- Why Do We Need Thermometers?
- Celsius and Fahrenheit, What's the Difference?
- Getting it JUST Right!
- Go!Temp Spends the Night
- Hold Everything! Comparing Insulators
- Keepin' it Cool! Design Your Own Thermos
- I'm Melting! Water Changes States
- Solid, Liquid, Gas: Water Can Do it All!

USING A TI LIGHT PROBE
- Learning to Use the Light Probe
- Distance From the Sun
- Sunshine on My Shoulders
- Summer and Winter
- Reflectivity of Light

USING A MOTION DETECTOR
- Learning to Use Go!Motion
- e-Motion
- Batty About Science
- Spring into Action
- Air Ball!
- Driving with Energy
- Weigh Station: All Trucks Stop!

USING A GAS PRESSURE SENSOR
- Learning to Use the Pressure Sensor
- Get a Grip!
- Under Pressure
- Bubbles in Your Bread

USING A MAGNETIC FIELD SENSOR
- Learning to Use the Magnetic Field Sensor
- Exploring the Poles
- Making Magnets
- Electromagnets

USING A DIFFERENTIAL VOLTAGE PROBE
- Learning to Use the Voltage Probe
- Are All Batteries the Same?
- Stacked Batteries
- All Worn Out!

USING A DUAL-RANGE FORCE SENSOR
- Learning to Use the Force Sensor
- Lift the Load
- What a Drag!
- Oh! My Aching Back! How Ramps Make Lifting Easier

STARTER PACKAGES | DELUXE PACKAGES | VIDEO ONLINE

Look for training videos of some of these labs at **www.vernier.com/videos**

Elementary Science LabQuest 2 and Go!Link Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

LABQUEST 2 CONNECTED SCIENCE SYSTEM

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-EL-ST	Deluxe Package LQ2-EL-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Stainless Steel Temperature Probe	TMP-BTA	$29	$29
TI Light Probe	TILT-BTA	$13	$13
Motion Detector	MD-BTD	$79	$79
Magnetic Field Sensor	MG-BTA		$58
Gas Pressure Sensor	GPS-BTA		$83
Differential Voltage Probe	DVP-BTA		$39
Dual-Range Force Sensor	DFS-BTA		$109
PACKAGE PRICE		**$450**	**$739**

YOU MAY ALSO NEED:

Elementary Science with Vernier **lab book**
ORDER CODE **EWV, $48.** See previous page.

Logger Lite software
Free download at **www.vernier.com/logger-lite**

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $717 EACH AND **SAVE $176!**

Go!Link

USB Computer Interface

GO!LINK INTERFACE & SENSORS	CODE	Starter Package ELEM-ST	Deluxe Package ELEM-DX
Vernier Go!Link Interface	**GO-LINK**	$61	$61
Go!Link Temperature Probe	GO-TEMP	$39	$39
TI Light Probe	TILT-BTA	$13	$13
Go!Motion - Motion Detector	GO-MOT	$109	$109
Magnetic Field Sensor	MG-BTA		$58
Gas Pressure Sensor	GPS-BTA		$83
Differential Voltage Probe	DVP-BTA		$39
Dual-Range Force Sensor	DFS-BTA		$109
PACKAGE PRICE		**$222**	**$511**

YOU MAY ALSO NEED:

Elementary Science with Vernier **lab book**
ORDER CODE **EWV, $48.** See previous page.

Logger Lite software
Free download at **www.vernier.com/logger-lite**

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $496 EACH AND **SAVE $120!**

MORE ONLINE – For additional elementary package options, visit www.vernier.com/elementary

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest and computers.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

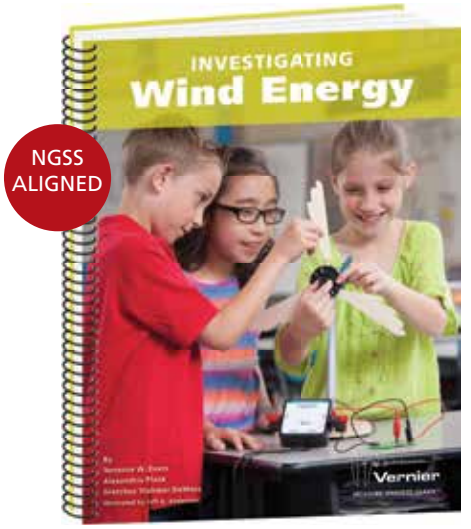
3 PURCHASE THE EQUIPMENT

Purchase the recommended equipment to perform every experiment in our wind energy lab book.

4 RECOMMENDED SOFTWARE

Logger Lite – Logger Lite makes collecting science and math data easier than ever. The simple interface makes learning intuitive by making science visual. See page 26 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.



NEW WIND ENERGY LAB BOOK

$25 ORDER CODE **ELB-WIND** GREAT VALUE!

Written for grades 4–6, this lab book is loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive

- EQuIP rubric friendly experiments—each shows connections to NGSS
- Essential teacher information
- 11 ready-to-use student versions of computer experiments in print; LabQuest and computer versions on CD
- A generous site license—buy one book and duplicate labs for your class
- Microsoft® Word® files for all versions of the experiments on CD so you can easily edit labs to meet your personal teaching style
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/elb-wind**

Investigating Wind Energy lab book contains the following experiments:

EXPERIMENT	SENSORS USED	LAB EQUIPMENT USED
1 Introduction to Wind Turbines	No sensor used	KidWind MINI Wind Turbine, KidWind Sound and Light Board*
2 Exploring Wind Energy	No sensor used	KidWind MINI Wind Turbine, KidWind Sound and Light Board*
3 Introduction to the Vernier Energy Sensor	Vernier Energy Sensor	KidWind MINI Wind Turbine, KidWind Sound and Light Board*
4 The Effect of Load on Wind Turbine Output	Vernier Energy Sensor	KidWind MINI Wind Turbine
5 Exploring Wind Turbine Blades	Vernier Energy Sensor	KidWind MINI Wind Turbine, Vernier Resistor Board
6 Blade Design: Pitch	Vernier Energy Sensor	KidWind MINI Wind Turbine, Vernier Resistor Board
7 Blade Design: Area	Vernier Energy Sensor	KidWind MINI Wind Turbine, Vernier Resistor Board
8 Blade Design: Quantity	Vernier Energy Sensor	KidWind MINI Wind Turbine, Vernier Resistor Board
9 Blade Design: Mass	Vernier Energy Sensor	KidWind MINI Wind Turbine, Vernier Resistor Board
10 Blade Design: Material	Vernier Energy Sensor	KidWind MINI Wind Turbine, Vernier Resistor Board
11 Project: Power Up!	Vernier Energy Sensor	KidWind MINI Wind Turbine, Vernier Resistor Board

* Included with MINI Wind Turbine with Blade Design

Did you know?

Integrating inquiry investigations and the engineering design method into your elementary STEM class is easy with the new *Investigating Wind Energy* lab book. Written for and aligned with the Next Generation Science Standards (NGSS), the investigations and project encourage students to apply learned knowledge as they explore electric circuits and design, test, and refine a wind turbine blade set that converts energy.

Products for Investigating Wind Energy

LabQuest 2 or LabQuest Mini		CODE	LABQUEST 2	LABQUEST MINI
	INTERFACE & SENSORS			
	CHOOSE ONE — **LabQuest 2**	**LABQ2**	$329	—
	CHOOSE ONE — **LabQuest Mini (computer)**	**LQ-MINI**	—	$149
	Vernier Energy Sensor	VES-BTA	$69	$69
	LAB EQUIPMENT			
	KidWind MINI Wind Turbine with Blade Design	KW-MWTBD	$49	$49
	Vernier Resistor Board	VES-RB	$18	$18

LabQuest 2 CONNECTED SCIENCE SYSTEM®

Standalone, Computer, or Tablet

Computer Only

LABQUEST 2
LABQUEST MINI

SOFTWARE:

Logger Lite software
Free download at **www.vernier.com/logger-lite**

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

VOLUME DISCOUNTS — CALL US AT **888-837-6437** FOR A PRICE QUOTATION

FEATURED PRODUCTS FOR K-8 RENEWABLE ENERGY EDUCATION

KidWind MINI Wind Turbine with Blade Design

ORDER CODE **KW-MWTBD, $49**

The MINI Wind Turbine with Blade Design allows students to perform basic blade experiments on a desk using a small house fan. This kit is recommended for use with our new book, *Investigating Wind Energy*. This kit includes the KidWind Sound and Light Board.

Vernier Energy Sensor

ORDER CODE **VES-BTA, $69**

Used in many of the experiments in the *Investigating Wind Energy* lab book, the Vernier Energy Sensor offers an easy way to quantify voltage, current, power, and energy output of small wind turbines and solar panels. Simply connect a source, such as a small wind turbine or solar panel, and a load, such as the Vernier Resistor Board or Variable Load.

Anemometer

ORDER CODE **ANM-BTA, $89**

The Vernier Anemometer is an impeller-type anemometer that measures wind speed in the range of 0.5 to 30 m/s (1 to 67 mph). The Anemometer fits in your palm for wind study measurements in the field. A standard camera mount on the back and an accessory rod allows you to position it in wind tunnels or in front of fans for wind turbine experiments.

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

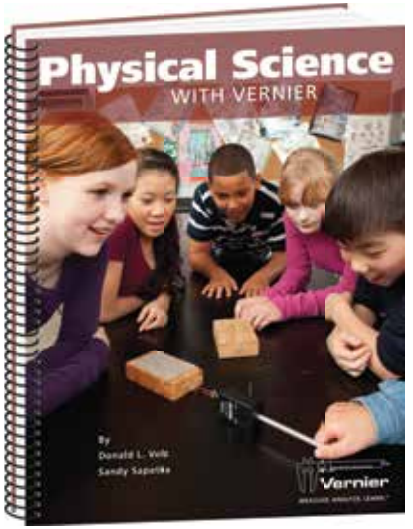
Our Deluxe Package contains all the sensors needed to perform every experiment in our physical science lab book.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide



PHYSICAL SCIENCE LAB BOOK

$48 ORDER CODE **PSV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive

- Essential teacher information
- 40 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD
- A generous site license—buy one book and duplicate labs for your class
- Microsoft® Word® files for all versions of the experiments on CD so you can easily edit labs to meet your personal teaching style
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/psv**

Physical Science with Vernier lab book contains the following experiments:

☐ ☐ **USING A TEMPERATURE PROBE**
- Temperature Probe Response Time
- Boiling Temperature of Water
- ▶ Freezing and Melting of Water
- Evaporation of Alcohols
- Endothermic and Exothermic Reactions
- Neutralization Reactions
- Mixing Warm and Cold Water
- Heat of Fusion
- Energy Content of Fuels
- Energy Content of Foods
- Absorption of Radiant Energy
- An Insulated Cola Bottle
- A Good Sock
- Insolation Angle
- Solar Homes and Heat Sinks
- Gas Temperature & Pressure

☐ ☐ **USING A MOTION DETECTOR**
- Velocity
- It's Race Day
- Momentum: A Crash Lesson
- Newton's Second Law
- Graphing Your Motion
- Falling Objects

☐ ☐ **USING A pH SENSOR**
- Household Acids and Bases
- Acid Rain

☐ ☐ **USING A VOLTAGE PROBE**
- Lemon "Juice"
- Lead Storage Batteries

☐ ☐ **USING A FORCE SENSOR**
- Frictional Forces
- First-Class Levers
- Pulleys
- ▶ An Inclined Plane

☐ ☐ **USING A LIGHT SENSOR**
- ▶ Reflectivity of Light
- Polaroid Filters
- How Bright is the Light?

☐ ☐ **MAGNETIC FIELD SENSOR**
- Electromagnets: Winding Things Up
- Magnetic Field Explorations

☐ ☐ **USING A CONDUCTIVITY PROBE**
- Conducting Solutions
- Conductivity of Salt Water
- Acid Strengths
- Neutralization Reactions

☐ ☐ **USING A GAS PRESSURE SENSOR**
- Gas Pressure and Volume
- Gas Temperature and Pressure
- Fun with Pressure

☐ STARTER PACKAGES ☐ DELUXE PACKAGES ▶ VIDEO ONLINE

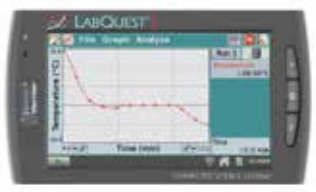
Look for training videos of some of these labs at **www.vernier.com/videos**

Interested in Middle School Science? See pp. 88–89.

Physical Science LabQuest 2 and LabQuest Mini Packages

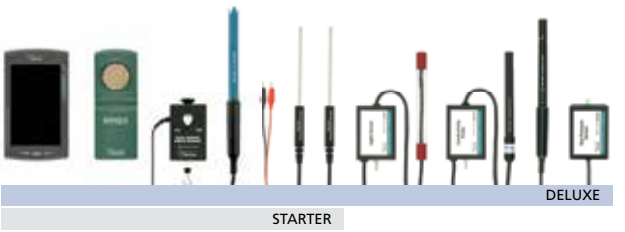
Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2



Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-PS-ST	Deluxe Package LQ2-PS-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Motion Detector	MD-BTD	$79	$79
Dual-Range Force Sensor	DFS-BTA	$109	$109
pH Sensor	PH-BTA	$79	$79
Voltage Probe	VP-BTA	$12	$12
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
Light Sensor	LS-BTA		$55
Conductivity Probe	CON-BTA		$95
Magnetic Field Sensor	MG-BTA		$58
Gas Pressure Sensor	GPS-BTA		$83
PACKAGE PRICE		**$666**	**$957**



YOU MAY ALSO NEED:

Physical Science with Vernier **lab book**
ORDER CODE **PSV, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $928 EACH AND **SAVE $232!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-PS-ST	Deluxe Package LM-PS-DX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
Motion Detector	MD-BTD	$79	$79
Dual-Range Force Sensor	DFS-BTA	$109	$109
pH Sensor	PH-BTA	$79	$79
Voltage Probe	VP-BTA	$12	$12
(2) Stainless Steel Temperature Probes	TMP-BTA	2 @ $29	2 @ $29
Light Sensor	LS-BTA		$55
Conductivity Probe	CON-BTA		$95
Magnetic Field Sensor	MG-BTA		$58
Gas Pressure Sensor	GPS-BTA		$83
PACKAGE PRICE		**$486**	**$777**

YOU MAY ALSO NEED:

Physical Science with Vernier **lab book**
ORDER CODE **PSV, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $754 EACH AND **SAVE $184!**

$79 a

$55 b

$12 c

a. Motion Detector, ORDER CODE MD-BTD, $79

The Motion Detector can be used to study the motion of a cart on a ramp or a ball tossed into the air. You can also use it to teach your students how graphs work by having them try to move in front of the motion detector to match a distance *vs.* time or velocity *vs.* time graph.

- Measure objects as close as 15 cm to the detector and as far away as 6 m.
- Pivoting head and rubber feet for ease of use

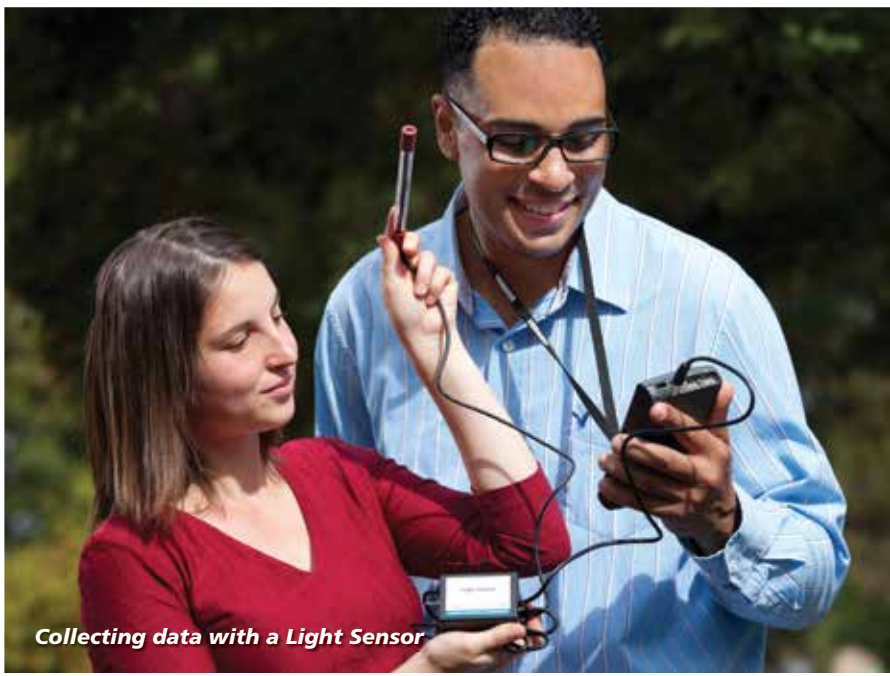
b. Light Sensor, ORDER CODE LS-BTA, $55

Our Light Sensor approximates the human eye in spectral response and can be used over three different illumination ranges, which you select with a switch. Use it for inverse square law experiments or for studying polarizers, reflectivity, or solar energy.

c. Voltage Probe, ORDER CODE VP-BTA, $12

The Voltage Probe can be used to study voltages produced by simple voltaic cells (like the lemon battery, top right), for simple electric circuit labs, or to do battery life studies.

***Experiment 33 from* Physical Science with Vernier, "Lemon Juice"**



Collecting data with a Light Sensor

Constant acceleration with the Fan Cart

PHYSICS

Getting Started

How to Choose an Interface **16**
Four Easy Steps **98**

Curriculum

Physics with Vernier **98**
Advanced Physics with Vernier – Mechanics **100**
Advanced Physics with Vernier – Beyond Mechanics **102**
Nuclear Radiation with Vernier **107**
Physics with Video Analysis **116**
Den of Inquiry **116**
Amusement Park Physics **116**

Outfitting Your Lab

PHYSICS
LabQuest 2 Packages **99**
• Standalone / Computer
LabQuest Mini Packages **99**
• Computer

ADVANCED PHYSICS
Mechanics **101**
Beyond Mechanics **103**

COLLEGE PHYSICS **100–103**

FEATURED PRODUCTS

INTERFACES
• Vernier LabQuest 2 **17–23**
• Vernier LabQuest Mini **24–25**

SENSORS & ACCESSORIES
• Centripetal Force Apparatus **101**
• Power Amplifier **104**
• Rotary Motion Sensor **104**
• Spectroscopy **105**
• Vernier Emissions Spectrometer **105**
• NEW Vernier Structures & Materials Tester **106**
• Radiation Monitor **107**
• Vernier Dynamics System **108–109**
• Vernier Motion Encoder System **110–111**
• NEW Fan Carts **112**
• Projectile Launcher **113**
• Vernier Optics System **114–115**
• Diffraction Apparatus **115**
• Video Physics **116**
• Wireless Dynamics Sensor System **117**

SOFTWARE
• Logger *Pro* **28–31**

1 IT ALL STARTS WITH CURRICULUM

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2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

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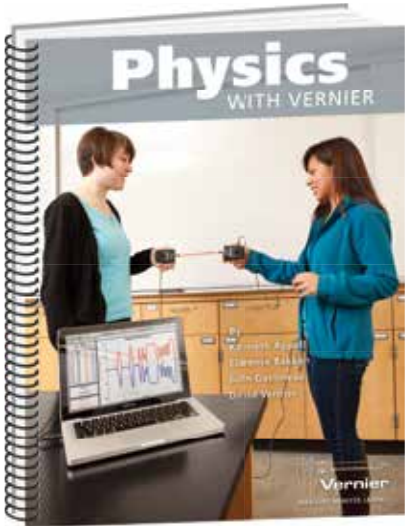
Choose from Vernier's recommended packages or build your own from our list of sensors.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide



PHYSICS LAB BOOK

$48 ORDER CODE **PWV** GREAT VALUE!

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive

- Essential teacher information
- 35 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD
- A generous site license—buy one book and duplicate labs for your class
- Editable labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at www.vernier.com/pwv

Physics with Vernier lab book contains the following experiments:

USING A MOTION DETECTOR
- Graph Matching
- Cart on a Ramp
- Determining *g* on an Incline
- Ball Toss
- Air Resistance
- Simple Harmonic Motion
- Energy of a Tossed Ball
- Energy in Simple Harmonic Motion
- Momentum, Energy and Collisions
- Impulse and Momentum
- Back and Forth Motion
- Static and Kinetic Friction

USING A FORCE SENSOR
- Newton's Second Law
- Newton's Third Law
- Static and Kinetic Friction
- Impulse and Momentum

USING A MICROPHONE
- Sound Waves and Beats
- Tones, Vowels, and Telephones
- Mathematics of Music
- Speed of Sound

USING A DIFFERENTIAL VOLTAGE PROBE
- Capacitors

USING PHOTOGATES
- Picket Fence Free Fall
- Projectile Motion
- Atwood's Machine
- Pendulum Periods

USING A TEMPERATURE PROBE
- Newton's Law of Cooling

USING AN ACCELEROMETER
- Bungee Jump Accelerations
- Centripetal Accelerations on a Turntable
- Accelerations in the Real World
- Newton's Second Law

USING CURRENT & DIFFERENTIAL VOLTAGE PROBES
- Ohm's Law
- Series and Parallel Circuits
- Electrical Energy

USING A MAGNETIC FIELD SENSOR
- The Magnetic Field in a Coil
- The Magnetic Field in a Slinky
- The Magnetic Field of a Permanent Magnet

USING A LIGHT SENSOR
- Polarization of Light
- Light, Brightness, and Distance

STARTER PACKAGES | DELUXE PACKAGES | VIDEO ONLINE

Look for training videos of some of these labs at **www.vernier.com/videos**

Lab Equipment used in these experiments

Vernier Dynamics System, pp. 108–109; **Picket Fence**, page 101; **Springs Set**, page 101; **Pulley Bracket**, page 101; **Optics Expansion Kit**, page 114; **Bumper and Launcher Kit**, page 109; **Polarizer/Analyzer Set for Optics Expansion Kit**, page 115; **Extech Digital DC Power Supply**, page 106; **Friction Pad**, page 109; **Independence of Motion Accessory**, page 113; **Time of Flight Pad**, page 113; **Circuit Board**, page 106; **Projectile Launcher**, page 113

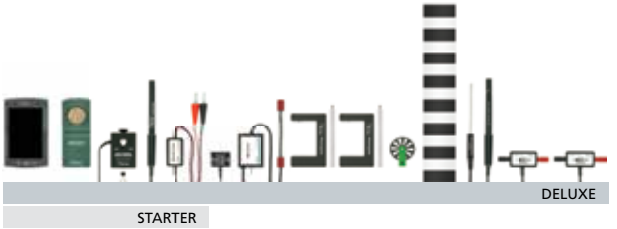
Physics LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS	CODE	Starter Package LQ2-PHY-ST	Deluxe Package LQ2-PHY-DX
Vernier LabQuest 2 Interface	**LABQ2**	$329	$329
Motion Detector	MD-BTD	$79	$79
Dual-Range Force Sensor	DFS-BTA	$109	$109
Microphone	MCA-BTA	$39	$39
Differential Voltage Probe	DVP-BTA	$39	2 @ $39
Low-g Accelerometer	LGA-BTA		$89
Light Sensor	LS-BTA		$55
(2) Vernier Photogates	VPG-BTD		2 @ $45
Ultra Pulley Attachment	SPA		$24
Picket Fence	PF		$7
Stainless Steel Temperature Probe	TMP-BTA		$29
Magnetic Field Sensor	MG-BTA		$58
(2) Current Probes	DCP-BTA		2 @ $39
PACKAGE PRICE		**$595**	**$1,064**



YOU MAY ALSO NEED:

***Physics with Vernier* lab book,** ORDER CODE **PWV, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,032 EACH AND **SAVE $256!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Starter Package LM-PHY-ST	Deluxe Package LM-PHY-DX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149	$149
Motion Detector	MD-BTD	$79	$79
Dual-Range Force Sensor	DFS-BTA	$109	$109
Microphone	MCA-BTA	$39	$39
Differential Voltage Probe	DVP-BTA	$39	2 @ $39
Low-g Accelerometer	LGA-BTA		$89
Light Sensor	LS-BTA		$55
(2) Vernier Photogates	VPG-BTD		2 @ $45
Ultra Pulley Attachment	SPA		$24
Picket Fence	PF		$7
Stainless Steel Temperature Probe	TMP-BTA		$29
Magnetic Field Sensor	MG-BTA		$58
(2) Current Probes	DCP-BTA		2 @ $39
PACKAGE PRICE		**$415**	**$884**

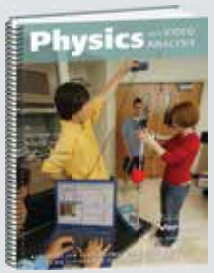
YOU MAY ALSO NEED:

***Physics with Vernier* lab book,** ORDER CODE **PWV, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

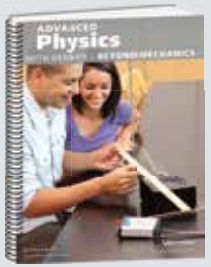
SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $857 EACH AND **SAVE $216!**

WE ALSO RECOMMEND:



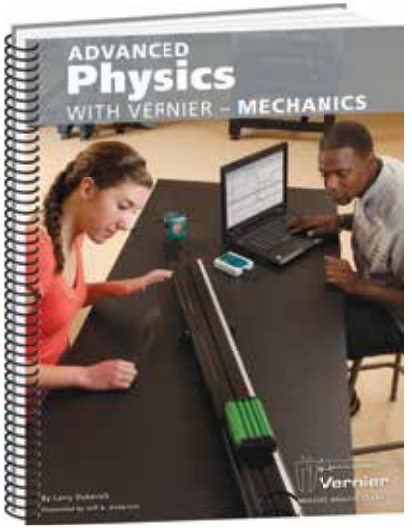
***Physics with Video Analysis* lab book**

ORDER CODE
PVA
$48
See page 116.



***Advanced Physics with Vernier – Beyond Mechanics* lab book**

ORDER CODE
PHYS-ABM
$48
See page 102.



ADVANCED PHYSICS – MECHANICS

$48 ORDER CODE **PHYS-AM** GREAT VALUE!

Advanced Physics with Vernier – Mechanics is the first of a two-volume set of experiments for the more in-depth introductory physics course, such as college physics, AP Physics, or IB Physics.

- Experiments are designed for an interactive teaching style, with planned moments for instructor or student-led discussion.
- Instructor notes include discussion on how to lead students to a successful activity.
- Includes many extensions to challenge the most talented students.
- Editable labs and supporting materials are included on CD.
- Includes a site license.
- Instructions are written to support data collection in Logger *Pro* or LabQuest App.

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/phys-am**

Advanced Physics with Vernier – Mechanics lab book contains the following experiments:

EXPERIMENT	SENSORS USED	LAB EQUIPMENT USED
1 Motion on an Incline	Motion Detector	Vernier Dynamics System
2 Error Analysis	Vernier Photogate	Picket Fence
3 Newton's First law	Motion Detector	Vernier Dynamics System, Bumper and Launcher Kit, Friction Pad
4 Newton's Second Law	Vernier Photogate, Dual-Range Force Sensor	Vernier Dynamics System, Bumper and Launcher Kit, Cart Picket Fence, Ultra Pulley, Pulley Bracket
5 Newton's Third Law	(2) Dual-Range Force Sensors	Vernier Dynamics System, Bumper and Launcher Kit
6 Projectile Motion	Video Analysis in Logger *Pro*	
7 Energy Storage and Transfer (Elastic)	Dual-Range Force Sensor	Vernier Dynamics System, Bumper and Launcher Kit
8 Energy Storage and Transfer (Kinetic)	Vernier Photogate	Vernier Dynamics System, Bumper and Launcher Kit, Cart Picket Fence
9 Energy Storage and Transfer (Gravitational)		Vernier Dynamics System, Bumper and Launcher Kit
10A Impulse and Momentum	Motion Detector, Dual-Range Force Sensor	Vernier Dynamics System, Bumper and Launcher Kit
10B Impulse and Momentum	Vernier Photogate, Dual-Range Force Sensor	Vernier Dynamics System, Bumper and Launcher Kit, Cart Picket Fence
11A Momentum and Collisions	(2) Motion Detectors	Vernier Dynamics System
11B Momentum and Collisions	(2) Vernier Photogates	Vernier Dynamics System, (2) Cart Picket Fence
12A Centripetal Acceleration	Vernier Photogate, Dual-Range Force Sensor	Centripetal Force Apparatus
12B Centripetal Acceleration	Vernier Photogate, Dual-Range Force Sensor	
13 Rotational Dynamics	Rotary Motion Sensor	Rotational Motion Accessory Kit
14 Conservation of Angular Momentum	Rotary Motion Sensor	Rotational Motion Accessory Kit
15 Simple Harmonic Motion - Mathematical Model	Motion Detector	Springs Set
16 Simple Harmonic Motion - Kinematics and Dynamics	Motion Detector, Dual-Range Force Sensor	Springs Set
17 Pendulum Periods	Rotary Motion Sensor	Rotational Motion Accessory Kit
18 Physical Pendulum	Rotary Motion Sensor	Rotational Motion Accessory Kit
19 Center of Mass	Video Analysis in Logger *Pro*	

Products for Advanced Physics – Mechanics

LabQuest 2 or LabQuest Mini		CODE	LABQUEST 2	LABQUEST MINI
	INTERFACE & SENSORS			
CHOOSE ONE	**LabQuest 2**	**LABQ2**	$329	—
	LabQuest Mini (Computer)	**LQ-MINI**	—	$149
	(2) Motion Detectors	MD-BTD	2 @ $79	2 @ $79
	(2) Vernier Photogates	VPG-BTD	2 @ $45	2 @ $45
	(2) Dual-Range Force Sensors	DFS-BTA	2 @ $109	2 @ $109
	Rotary Motion Sensor	RMV-BTD	$169	$169
	LAB EQUIPMENT			
CHOOSE ONE	**Vernier Dynamics System**	**VDS**	$279 OR $424	$279 OR $424
	or **Motion Encoder System**	**VDS-EC**		
	Ultra Pulley Attachment	SPA	$24	$24
	Pulley Bracket	B-SPA	$12	$12
	Bumper and Launcher Kit	BLK	$89	$89
	Cart Friction Pad	PAD-VDS	$30	$30
	Picket Fence	PF	$7	$7
	(2) Cart Picket Fences	PF-CART	2 @ $6	2 @ $6
	Rotational Motion Accessory Kit	AK-RMV	$110	$110
	Centripetal Force Apparatus	CFA	$399	$399
	Spring Set	SPRINGS	$16	$16

LabQuest 2 CONNECTED SCIENCE SYSTEM®

Standalone, Computer, or Tablet

Computer Only

YOU MAY ALSO NEED:

Advanced Physics with Vernier – Mechanics **lab book** ORDER CODE **PHYS-AM, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

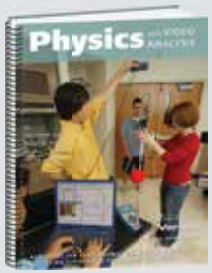
VOLUME DISCOUNTS CALL US AT **888-837-6437** FOR A PRICE QUOTATION

CENTRIPETAL FORCE APPARATUS $399* ORDER CODE CFA

The Centripetal Force Apparatus allows you to investigate the relationship among centripetal force, angular velocity, mass, and radius. A force sensor measures the centripetal force exerted on a mass as it moves in a circle. A photogate can be used to measure the angular speed. Different masses can be added to the platform and positioned at variable radii. The platform can be driven by a falling mass. The apparatus also accommodates the Vernier Wireless Dynamics Sensor System to measure force, which provides the best set of data. Sensors are sold separately. **www.vernier.com/cfa**

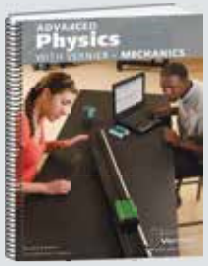
*Additional shipping charges may apply due to weight.

WE ALSO RECOMMEND:



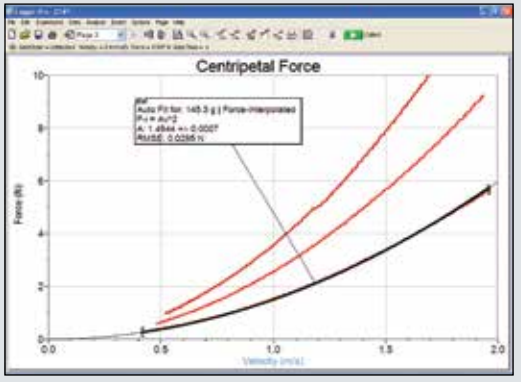
Physics with Video Analysis **lab book**

ORDER CODE
PVA
$48
See page 116.



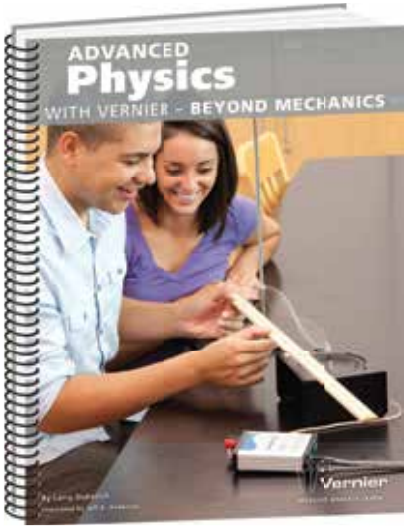
Advanced Physics with Vernier – Mechanics **lab book**

ORDER CODE
PHYS-AM
$48
See page 100.



Centripetal force vs. velocity for three different masses, collected using the Vernier Centripetal Force Apparatus

MORE ONLINE – For FREE sample activities and videos go to **www.vernier.com/experiments**



BEYOND MECHANICS LAB BOOK

$48 ORDER CODE **PHYS-ABM** GREAT VALUE!

Advanced Physics with Vernier – Beyond Mechanics is the second of a two-volume set of experiments for the more in-depth introductory physics course, such as college physics, AP Physics, or IB Physics. When you buy the lab book, you will receive

- Complete student experiments with a materials list, instructions for data collection on a computer or LabQuest, data tables, and questions
- Teacher Information section for each experiment with complete directions for setting up experiments, helpful hints, sample graphs, and data
- Word-processing files of the student sections on a CD so that any experiment may be easily edited to your specifications (Microsoft® Word® files)
- CD with support material including videos

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/phys-abm**

Advanced Physics with Vernier – Beyond Mechanics lab book contains the following experiments:

EXPERIMENT	SENSORS USED	LAB EQUIPMENT USED
1 Ideal Gas Law	Gas Pressure Sensor, Stainless Steel Temperature	
2 Heat Engines	Gas Pressure Sensor, Stainless Steel Temperature	
3 Standing Waves on a String	Power Amplifier	Power Amplifier Accessory Speaker
4 Standing Waves in a Tube	Microphone	
5 Doppler Effect with Water Waves	No probeware used	
6 Electrostatics	Charge Sensor	Electrostatics Kit
7 Coulomb's law	No probeware used	
8 Field Mapping	Differential Voltage Probe	Power Amplifier or Power Supply
9 Factors Affecting Resistance	Instrumentation Amplifier, Current Probe†	Power Amplifier or Power Supply, Resistivity Rod Set
10 Series and Parallel Circuits	Differential Voltage Probe, Current Probe	Vernier Circuit Board
11 Faraday's Law - Moving Magnet	Instrumentation Amplifier	
12 Faraday's Law - Alternating Current	Instrumentation Amplifier	Power Amplifier
13 RC and RL circuits	Differential Voltage Probe, Current Probe	Inductor, Vernier Circuit Board
14 RLC Circuits	Differential Voltage Probe, Current Probe	Power Amplifier, Inductor
15 Mirrors and Real Images		Optics Expansion Kit, Mirror Set*
16 Thin Lenses and Real Images		Optics Expansion Kit*
17 Thin Lenses and Virtual Images		Optics Expansion Kit*
18 Aperture and Depth of Field		Optics Expansion Kit*
19 Interference		Diffraction Apparatus*
20 Diffraction		Diffraction Apparatus*
21 Rydberg Constant	Red Tide Emission Spectrometer, Optical Fiber	Emission Tubes
22 Planck's Constant	Differential Voltage Probe	

† Current Probe needed if using a conventional power supply. * These accessories require the Vernier Dynamics track. (ORDER CODES VDS or TRACK, page 109).

Products for Advanced Physics – Beyond Mechanics

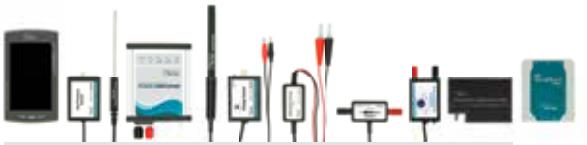
LabQuest 2 or LabQuest Mini

LABQUEST 2
CONNECTED SCIENCE SYSTEM

Standalone, Computer, or Tablet

Computer Only

		CODE	LABQUEST 2	LABQUEST MINI
INTERFACE & SENSORS				
CHOOSE ONE	**LabQuest 2**	**LABQ2**	$329	—
	LabQuest Mini (computer)	**LQ-MINI**	—	$149
Gas Pressure Sensor		GPS-BTA	$83	$83
Stainless Steel Temperature Probe		TMP-BTA	$29	$29
Power Amplifier		PAMP	$199	$199
Microphone		MCA-BTA	$39	$39
Charge Sensor		CRG-BTA	$75	$75
Differential Voltage Probe		DVP-BTA	$39	$39
Current Probe		DCP-BTA	$39	$39
Instrumentation Amplifier		INA-BTA	$69	$69
Emissions Spectrometer		VSP-EM	$799	$799
Optical Fiber		VSP-EM-FIBER	$88	$88
Diffraction Apparatus		DAK	$549	$549
LAB EQUIPMENT				
Power Amplifier Accessory Speaker		PAAS-PAMP	$99	$99
Electrostatics Kit		ESK-CRG	$109	$109
Resistivity Rod Set		RRS	$45	$45
Vernier Circuit Board		VCB	$89	$89
Inductor		IND	$40	$40
Optics Expansion Kit		OEK	$169	$169
Mirror Set		M-OEK	$59	$59



LABQUEST 2
LABQUEST MINI

SOFTWARE:

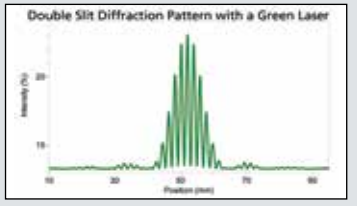
Logger *Pro* 3 software, ORDER CODE **LP, $249**
See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

VOLUME DISCOUNTS CALL US AT **888-837-6437** FOR A PRICE QUOTATION

DIFFRACTION APPARATUS $549 ORDER CODE DAK

The Diffraction Apparatus consists of a laser light source, a collection of diffraction and interference slits, and a novel Linear Position Sensor and High Sensitivity Light Sensor. Map light intensity versus position for many slit geometries. Mounts on a Vernier Dynamics System Track (not included).



Double-slit diffraction pattern with 0.04 mm slits separated by 0.25 mm, 532 nm laser wavelength

$199 a

$99 b

$169 c

$110 d

$245 e

a. Power Amplifier, ORDER CODE **PAMP, $199**

The Vernier Power Amplifier allows you to drive loads with ±10 V and currents up to 1 A. Works with any waveform, including DC, sine, square, triangle, and sawtooth waveforms. The Power Amplifier can drive a variety of loads, including speakers, lamps, small DC motors, and RLC circuits. More on page 154.

b. Power Amplifier Accessory Speaker
ORDER CODE **PAAS-PAMP, $99**

This kit includes a speaker and accessories used with the Vernier Power Amplifier to study mechanical waves and springs. The speaker contains a lightweight metal disc glued to the speaker cone. A drive post attached to the metal plate allows you to drive elastic materials, such as strings and springs.

c. Rotary Motion Sensor
ORDER CODE **RMV-BTD, $169**

Our Rotary Motion Sensor lets you monitor angular motion precisely and easily, and it is direction sensitive. Use it to collect angular displacement, angular velocity, and angular acceleration data.

d. Rotational Motion Accessory Kit
ORDER CODE **AK-RMV, $110**

This accessory kit is used to study the motion of a physical pendulum; the rotational inertia of disks, rings, and point masses; and the conservation of angular momentum.

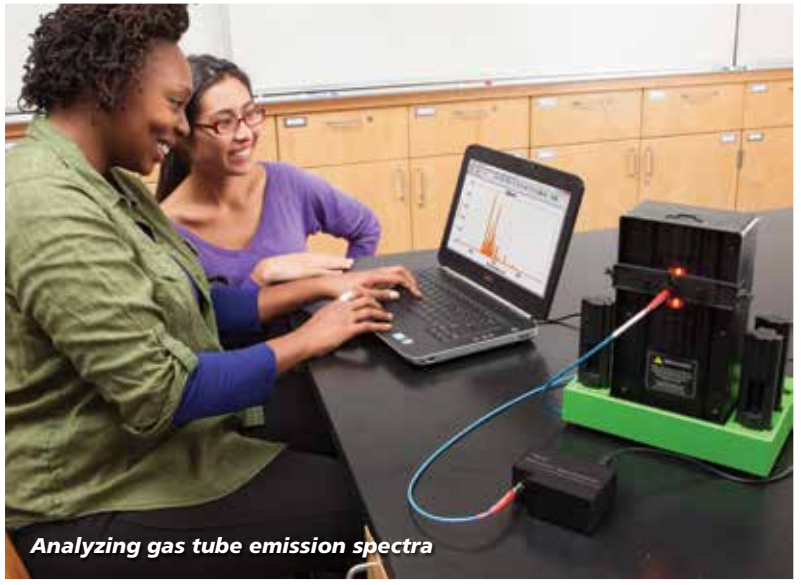
e. Force Plate, ORDER CODE **FP-BTA, $245***

The Force Plate is a large force sensor—tough enough to jump on. About the size and shape of a bathroom scale, the Force Plate has two ranges: one reading up to 3500 N, and the other to 800 N. Two handles are included for pushing or pulling. Additional pairs of handles are available (ORDER CODE FP-HAN, $15).

*Additional shipping charges may apply due to weight.

Experiment 32 from* Physics with Vernier, *"Sound Waves and Beats"

Exploring Newton's third law



Analyzing gas tube emission spectra

Spectrum Tube Carousel Power Supply

ORDER CODE **ST-CAR, $292**

The Spectrum Tube Carousel Power Supply features the same ultra-safe, patented design of the Spectrum Tube Single Power Supply version but holds eight gas spectrum tubes simultaneously. You can quickly switch from one gas to another without handling the tubes. Includes a Spectrum Tube Fiber Optic Holder.

The Vernier Emissions Spectrometer and Optical Fiber are used here with the Spectrum Tube Carousel Power Supply.

a. Vernier Emissions Spectrometer

ORDER CODE **VSP-EM, $799**

This is the perfect tool to conduct emissions analysis. It connects directly to your computer or LabQuest with a standard USB cable and gives precise measurements over a range of 350–900 nm. Use the Vernier Emissions Spectrometer with or without an optical fiber to examine spectra of light bulbs, spectrum tubes, or the sun.

b. Vernier Emissions Fiber

ORDER CODE **VSP-EM-FIBER, $88**

This 400 µm diameter optical fiber is used to pipe light from sources to a spectrometer.

c. Spectrum Tube Single Power Supply

ORDER CODE **ST-SPS, $229**

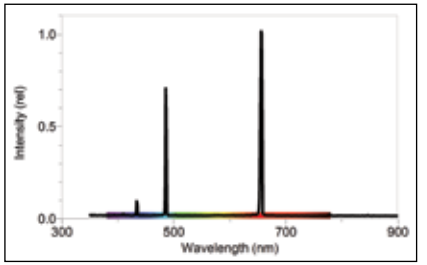
The Spectrum Tube Single Power Supply provides an ultra-safe means of generating gas discharges. View the spectral lines with one of our spectrometers such as the Emissions Spectrometer described above. With no exposed high voltage, tubes are permanently enclosed in protective plastic carriers. There are no through-the-glass electrodes, so tubes are long lasting. One tube is energized at a time, and there are storage slots for six more tubes. Includes a Spectrum Tube Fiber Optic Holder. All Spectrum Tubes are sold separately:

Hydrogen, ORDER CODE **ST-H, $37**
Nitrogen, ORDER CODE **ST-N, $37**
Helium, ORDER CODE **ST-HE, $37**
Neon, ORDER CODE **ST-NE, $37**
Carbon Dioxide, ORDER CODE **ST-CO2, $37**
Air, ORDER CODE **ST-AIR, $37**
Argon, ORDER CODE **ST-AR, $37**

Spectrum Tube Power Supplies carry a two-year warranty*.

* Two years or 40 hours, whichever comes first, on the hydrogen tube. Two years or 100 hours, whichever comes first, on all other gas tubes.

a $799



b $88

c $229

$89 (a)

$199 (b)

$12 (c)

a. Vernier Circuit Board, ORDER CODE **VCB, $89**

The Vernier Circuit Board is a simple board that makes it easy to create circuits without a lot of loose components. Includes a self-resetting fuse, two powering options, resistors, capacitors, an LED, lamps, and binding posts to add your own components.

The Vernier Circuit Board is used in *Physics with Vernier* and *Advanced Physics with Vernier–Beyond Mechanics* experiments.

---

b. Extech Digital DC Power Supply

ORDER CODE **EXPS, $199***

The Extech® Digital DC Power Supply has three outputs: adjustable 0–30 V at 0–3 A, fixed 5 V, and fixed 12 V. It provides constant current or constant voltage modes and has overload and short circuit protection. Binding post terminals are provided for the variable supply. Easy snap terminals are provided for the 5 V and 12 V outputs. The front panel contains digital voltage and current meters for the variable output, so you won't need additional metering in a typical experiment. The Extech Digital DC Power Supply comes with a one-year warranty.

The Extech Digital DC Power Supply is used in *Physics with Vernier* and *Advanced Physics with Vernier–Beyond Mechanics* experiments.

*Additional shipping charges may apply due to weight.

---

c. Rotary Motion Motor Kit

ORDER CODE **MK-RMV, $12**

The Rotary Motion Motor Kit includes a small electric motor with pulley, rubber band belt, motor clip, and mounting screw. The motor can be attached to the Rotary Motion Sensor and be used as an analog tachometer or generator. You can also perform experiments that investigate motor efficiency in different conditions.

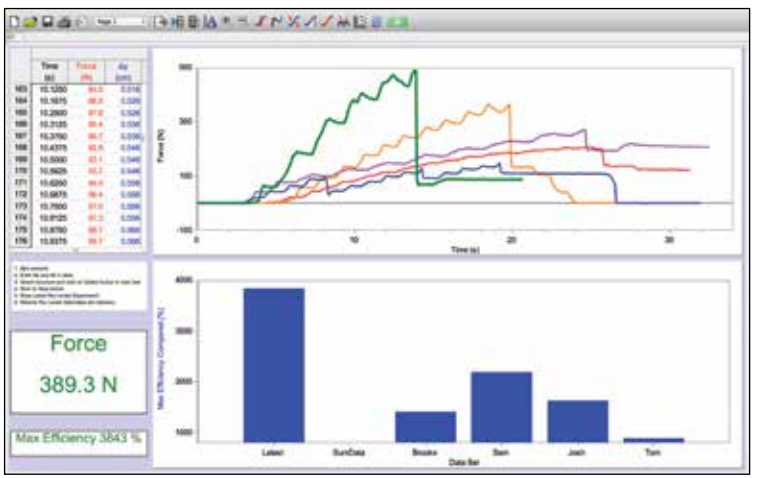
Structures & Materials Tester

NEW Vernier Structures & Materials Tester

$999 ORDER CODE **VSMT**

The new Vernier Structures & Materials Tester brings excitement to physics classes when it is used to hold a bridge or truss design contest. Conducting these events was never easier.

Use the Vernier Structures & Materials Tester to test the strength of materials, determine a modulus of elasticity, or teach vectors by testing trusses. The Tester is equipped with a load cell (measuring up to 1000 N) and a displacement sensor (0.1 mm resolution). Using both sensors allows you to record maximum breaking loads, as well as load/displacement characteristics to allow students to evaluate stress and strain. Use Logger *Pro* to replay a video taken during bridge testing to show graphical data of the bridge as it is pushed to its limits. See page 71 for more information.



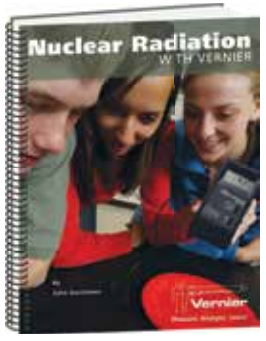
Bridge Competition experiment file allows for side-by-side comparison of student structures.

Radiation Monitor and Lab Book

Vernier Radiation Monitor

$169 ORDER CODE **VRM-BTD**

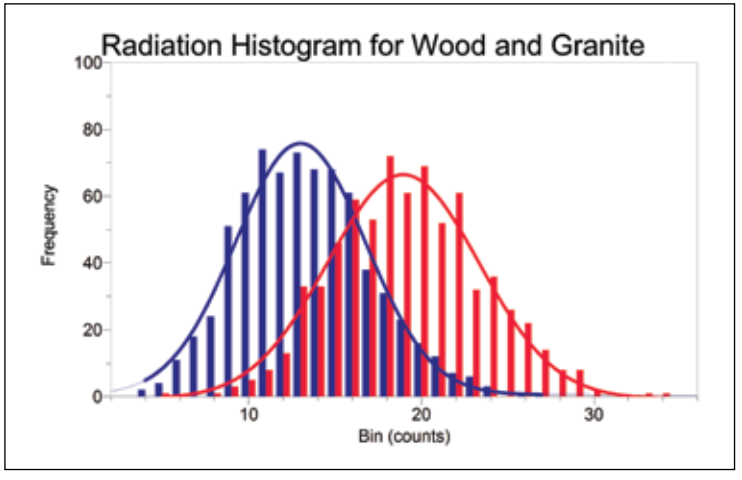
The Vernier Radiation Monitor detects alpha, beta, gamma, and X-ray radiation using a Geiger-Mueller tube. Use the Monitor for experiments in nuclear counting statistics, shielding, and decay rate measurements. No battery is required, as the Monitor gets power from the interface, such as LabQuest 2.



Nuclear Radiation with Vernier lab book *by John Gastineau*

$25 ORDER CODE **NRV**

This book contains six experiments for data collection using our Radiation Monitor: Distance and Radiation; Counting Statistics; Lifetime Measurement; Background Radiation Sources; Radiation Shielding; and Alpha, Beta, and Gamma.



Count histograms for wood and granite countertops show the slight natural radioactivity of granite.

a. Charge Sensor, ORDER CODE CRG-BTA, $75

The Charge Sensor is used as an electronic electroscope. An extremely high impedance voltage sensor with a 0.01 µF input capacitor makes possible quantitative measurements in many electrostatic experiments. The sensor has three operating ranges and a zeroing switch to discharge the input capacitor. For detailed specifications, see page 141.

b. Electrostatics Kit

ORDER CODE **ESK-CRG, $109**

The Electrostatics Kit is an accessory for the Vernier Charge Sensor. This kit allows students to perform a range of experiments in electrostatics, including the use of Faraday's Pail, quantitative and qualitative measurement of charge, charging by friction, charging by contact, and charging by induction. The kit includes

- Faraday Pail and cage
- Grounding plane
- Grounding wires and wrist strap
- Charge producers and proof plane
- Wool, vinyl, nylon rod, and PVC rod
- Cotton cloth

c. High-Voltage Electrostatics Kit

ORDER CODE **HVEK-CRG, $249**

The High-Voltage Electrostatics Kit is an accessory for the Vernier Charge Sensor. Use it with a Faraday Pail and the Charge Sensor to investigate the distribution of charge on a sphere, transfer of charge on contact between two spheres, and charging by induction. The kit includes an electrostatics voltage source (output 750, 1500, 3000, 6000 VDC) and two conducting spheres. Extremely low output current makes this device safe for classroom use.

a $75

b $109

c $249

Vernier Dynamics Carts

- Designed for kinematics and dynamics experiments.
- Easily attach a Dual-Range Force Sensor or our Wireless Dynamics Sensor System.
- Use them with our Motion Detector.
- Roll the cart down a ramp to study constant acceleration.
- Use two carts to study momentum conservation.
- With extremely low friction due to sealed bearings and machined wheels, our superior carts give very high quality data.
- Interchangeable magnetic and hook-and-pile end caps make it possible to do many experiments.
- The Plunger Cart has a spring-loaded plunger for consistent collisions, while the Standard Cart is similar, but has no plunger.
- Vernier carts are compatible with other common carts and tracks.

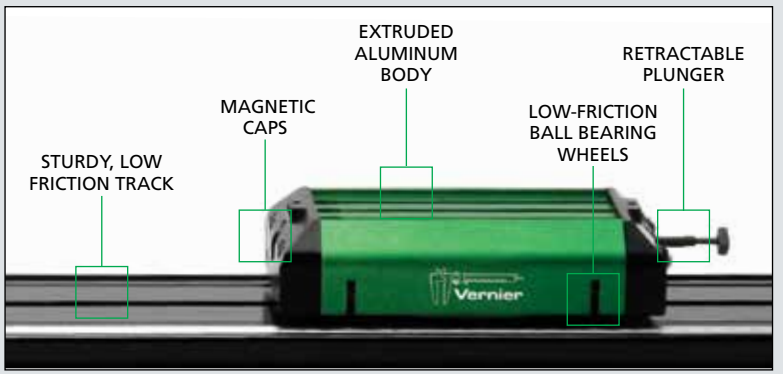
EXPERIMENTS FOR CART AND TRACK

- Determining *g* on an Incline
- Newton's Second Law
- Momentum, Energy, and Collisions
- Impulse and Momentum
- Back and Forth Motion
- Cart on a Ramp
- Static and Kinetic Friction

These experiments can be found in our Physics with Vernier *lab book (see page 98). Additional experiments can be found in* Advanced Physics with Vernier–Mechanics *(see page 100).*

Dynamics Cart with WDSS attached

Dual-Range Force Sensor and Accelerometer



2.2 m Track

$229 ORDER CODE **TRACK-LONG**

For Wireless Dynamics Sensor System, see page 117.

BUMPER AND LAUNCHER KIT

$89 ORDER CODE **BLK**

Contains accessories for experiments involving the Vernier Dual-Range Force Sensor, Vernier Wireless Dynamics Sensor System, and the Vernier Dynamics System. The accessories allow you to perform a wide range of experiments in kinematics and dynamics.

Vernier Bumper and Launcher Kit Includes

- One track bracket
- One dual-magnet bumper
- One DFS end mount screw
- Two magnetic bumpers
- Two rubber bumpers
- Two hoop bumpers
- Two clay holders
- About 20 grams of clay

Vernier Dynamics System

Use the Vernier Dynamics System to improve your kinematics and dynamics experiments. The Dynamics System is ideal for studying Newton's second law, acceleration on an inclined plane, momentum, and much more. Vernier sensors, such as our Motion Detector, Dual-Range Force Sensor, Wireless Dynamics Sensor System, Photogate, and Accelerometer, easily attach to the Dynamics System. Make the most of your track by adding the Vernier Optics Expansion Kit for studying optics. See pp. 114–115.

$279* ORDER CODE **VDS**

Vernier Dynamics System Includes

- Combination 1.2 m Dynamics Track/Optics Bench
- Standard Cart with magnetic and hook-and-pile end caps
- Plunger Cart with magnetic and hook-and-pile end caps
- Mass – 500 g
- Adjustable End Stop
- 2 Adjustable Two Foot Levelers
- Motion Detector Bracket
- 2 Photogate Brackets
- Rod Clamp

VERNIER DYNAMICS SYSTEM WITH LONG TRACK

$399* ORDER CODE **VDS-LONG**

The long-track version includes the same carts and accessories as the standard system but substitutes a 2.2 m Track for the 1.2 m Track.

VERNIER MOTION ENCODER SYSTEM

$424* ORDER CODE **VDS-EC** See pp. 110–112.

Fan Cart

$94 ORDER CODE **CART-F**

Friction Pad

$30 ORDER CODE **PAD-VDS**

Pulley Bracket

$12 ORDER CODE **B-SPA**

Ultra Pulley Attachment

$24 ORDER CODE **SPA**

MORE DYNAMICS SYSTEM ACCESSORIES

Additional 1.2 m Track, ORDER CODE **TRACK, $119***
2.2 m Track, ORDER CODE **TRACK-LONG, $229***
Standard Cart, ORDER CODE **CART-S, $89**
Plunger Cart, ORDER CODE **CART-P, $109**
Cart Picket Fence, ORDER CODE **PF-CART, $6**

*Additional shipping charges may apply.

Vernier Motion Encoder System*

Optical Motion Sensing

See Better Dynamic Data with Optical-Only Sensors

The Motion Encoder Cart replaces the ultrasonic Motion Detector when used for dynamics cart-on-track activities. An optical sensor beneath the dynamics cart senses the passage of the cart over a marked strip on the track. The position information is sent as an encoded IR signal to a receiver at the track's end. By avoiding the possibility of stray sound reflections, this optical-only system provides excellent, repeatable, and noise-resistant motion data.

Because the position information is relayed by a narrow IR beam, multiple Motion Encoder Carts can be used in a single lab. Two can even be used at a time on a single track, allowing students to study collisions.

If you have ever been frustrated by the need to tweak the alignment of a motion detector, you will be pleased by the data your students collect using the Vernier Motion Encoder System.

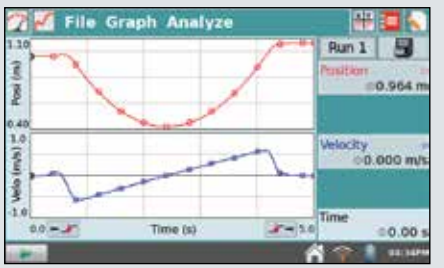
* Patent Pending

PRODUCT DETAILS

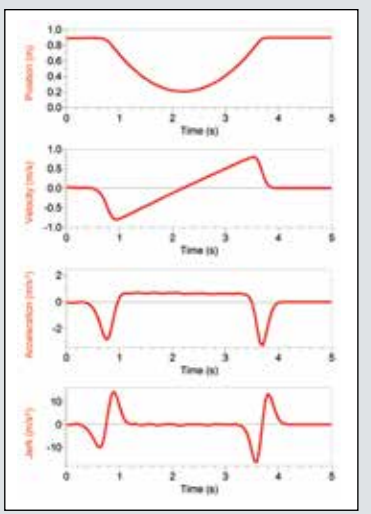
- Resolution: 1 mm
- Max useful data rate: 30 Hz
- Supports: 1.2 and 2.2 m tracks

SENSOR REQUIREMENTS

The sensor portion of the Vernier Motion Encoder System, the Motion Encoder Cart Receiver, requires an interface to function. It is compatible with the original LabQuest, LabQuest 2, LabQuest Mini, and LabPro.



The Motion Encoder Cart on a ramp displays uniform acceleration.



Even the graphs of acceleration and jerk are pristine for a cart on a ramp.

Studying a cart under constant acceleration using a Vernier Motion Encoder System

HOW TO DETERMINE WHICH PARTS TO BUY	
I have no carts and tracks at all.	Buy the Vernier Motion Encoder System (VDS-EC, $424).
I have a Vernier Dynamics System.	Buy the Motion Encoder Upgrade Kit (MEU-VDS, $145). With a few minutes of work, you can convert an existing cart to an Encoder Cart.
I have a Vernier Dynamics System but would rather just get an additional cart.	Buy the Motion Encoder Cart and Receiver (MEC-VDS, $229) to add to your existing Vernier Dynamics System.

Vernier Motion Encoder System

ORDER CODE **VDS-EC, $424***

The Vernier Motion Encoder System is a complete dynamics system with all the parts of the standard Vernier Dynamics System, but with a Motion Encoder Cart substituted for the standard cart. A Motion Encoder Receiver is included.

Vernier Motion Encoder System includes

- Combination 1.2 m Dynamics Track/Optics Bench
- Motion Encoder Cart with magnetic and hook-and-pile end caps
- Motion Encoder Receiver
- Plunger Cart with magnetic and hook-and-pile end caps
- Mass – 500 g
- Adjustable End Stop
- 2 Adjustable Two Foot Levelers
- Motion Detector Bracket
- 2 Photogate Brackets

Vernier Motion Encoder System with Long Track

ORDER CODE **VDS-EC-LONG, $534***

This system includes the parts listed above, but it substitutes a 2.2 m Track for the 1.2 m Track.

* Additional shipping charges may apply due to weight.

UPGRADE KITS

Motion Encoder Upgrade Kit

ORDER CODE **MEU-VDS, $145**

The Motion Encoder Upgrade Kit is for owners of the Vernier Dynamics System. The kit allows you to upgrade one existing cart to a Motion Encoder Cart and includes the Motion Encoder Receiver and a Motion Encoder Track Strip. One-time assembly is required to modify your cart.

Motion Encoder Cart and Receiver

ORDER CODE **MEC-VDS, $229**

The Motion Encoder Cart and Receiver is for owners of the Vernier Dynamics System who want to add a complete Motion Encoder Cart. No assembly is required. It includes a fully assembled Motion Encoder Cart, as well as the Motion Encoder Receiver and a Motion Encoder Track Strip.

MORE ONLINE – www.vernier.com/motion-encoder-system

Motion Encoder Cart

Motion Encoder Receiver

Track

NEW a $94

NEW b $199

NEW c $107

NEW Fan Carts

The Fan Cart is a large fan on a lightweight cart. It offers students the ability to perform kinematics and dynamics experiments with constant acceleration, variable mass, variable thrust, and variable thrust angle.

The fan has three speeds for studying the effect of variable thrust. Two mass bars let you change the total mass of the cart to observe how mass affects acceleration. The fan turns on a protractor base, allowing the thrust to be directed at a known angle from the direction of travel. In this way, students can understand vector component applications.

A sail is included to perform the fan-on-a-sailboat experiment. The sail can be mounted in two positions to study the subtle effects of diverted airflow.

Although the cart can be used for qualitative experiments alone, most often it is used with a Motion Detector on a Dynamics Track.

a. NEW Fan Cart, ORDER CODE **CART-F, $94**

Use with a Motion Detector and the Vernier Dynamics System. The Fan Cart requires four AA batteries (not included).

b. NEW Encoder Fan Cart, ORDER CODE **CART-FEC, $199**

Use with the Motion Encoder System. The Encoder Fan Cart requires four AA batteries (not included) and the Motion Encoder Transmitter requires two AAA batteries (not included).

c. NEW Encoder Fan Cart Upgrade Kit
ORDER CODE **FECT, $107**

The Encoder Fan Cart Upgrade Kit is used to convert a Fan Cart to an Encoder Fan Cart. Two AAA batteries (not included) are required for the encoder transmitter.

Data collection with the Encoder Fan Cart

WHICH FAN CART IS RIGHT FOR ME?	
I have a Vernier Motion Encoder System.	Buy the Encoder Fan Cart (CART-FEC, $199).
I have a Vernier Dynamics System.	Buy the Fan Cart (CART-F, $94).
I have a Fan Cart but would like an Encoder Fan Cart.	Buy the Encoder Cart Upgrade Kit (FECT, $107) to add to your existing Fan Cart. With a few minutes of work you can convert an existing cart to an Encoder Cart.

Projectile Launcher

$299 ORDER CODE VPL

a. Projectile Launcher, ORDER CODE VPL, $299*

Use the Vernier Projectile Launcher to investigate important concepts in two-dimensional kinematics. Launch steel balls at angles between 0 and 70 degrees and up to a distance of 2.5 m. A unique pneumatic launching system provides excellent repeatability and allows you to adjust the launch speed. Built-in photogates and angle markings provide easy and accurate measurement of the ball's launch velocity, allowing for precise quantitative analysis of projectile motion.

Includes: launcher, six steel balls, hand pump, two pairs of goggles, level, roll of waxed marking paper, photogate cable

Product Specifications

Launch angle: 0 to 70 degrees
Launch speed: 0 to 6 m/s
Launch height: 146 mm
Internal photogate interval: 50 mm
Steel ball mass: 21.8 g
Steel ball diameter: 17.5 mm

*Additional shipping charges may apply.

b. Projectile Stop, ORDER CODE PS-VPL, $40

The Projectile Stop has one job: to keep the projectiles from the Vernier Projectile Launcher from rolling out of sight. Place the Projectile Stop in the launch line, beyond the landing site, and the projectile will be caught.

c. Time of Flight Pad, ORDER CODE TOF-VPL, $77

The Time of Flight Pad is used to precisely measure how long a projectile has been in motion. Use it with the Vernier Projectile Launcher and a Vernier interface to determine the launch speed of a projectile, along with the time the projectile is in flight.

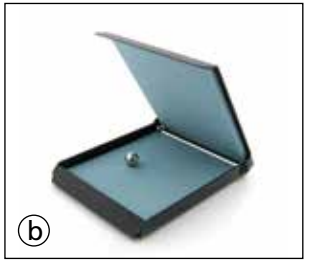
d. Independence of Motion Accessory, ORDER CODE IOM-VPL, $49

The Independence of Motion Accessory enables the Vernier Projectile Launcher to perform the classic experiment where one ball is dropped as another is projected horizontally. The balls strike the floor simultaneously.

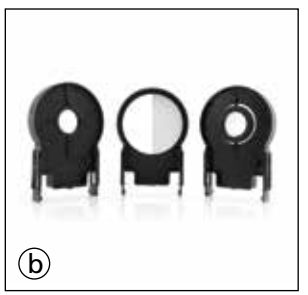
The Projectile Launcher and accessories are used in *Physics with Vernier* experiments.

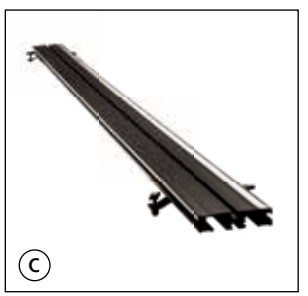
MORE ONLINE – For more information on the Projectile Launcher, visit **www.vernier.com/vpl**

Measuring the time of flight of a projectile



Viewing an inverted image using a single thin lens from the Optics Expansion Kit mounted on the Vernier Dynamics System Track





Vernier Optics System

Expand the use of your Vernier dynamics systems by adding these optics products.

$169 ORDER CODE OEK

a. Optics Expansion Kit, ORDER CODE OEK, $169

Add the Vernier Optics Expansion Kit to your dynamics track to conduct optics experiments, such as image formation with lenses and light intensity *vs.* distance. You can even use the kit to build a basic telescope.

Vernier Optics Expansion Kit includes

- Three lens holders with bases
- 100 mm converging lens
- 200 mm converging lens
- -150 mm diverging lens
- Screen, holder, and base
- Combination luminous and point light source
- Light Sensor holder
- Aperture screen
- Power Supply

The Optics Expansion Kit extends the capabilities of the Vernier dynamics system track (sold separately).

Download free sample experiments online at **www.vernier.com/oek**

The Optics Expansion Kit is also used in *Physics with Vernier* and *Advanced Physics with Vernier—Beyond Mechanics* experiments.

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b. Mirror Set, ORDER CODE M-OEK, $59

The Mirror Set for the Optics Expansion Kit extends the kit to allow students to easily study image formation by concave and convex mirrors. Includes a concave mirror, a convex mirror, and a half screen for viewing images formed by the mirrors. Requires components from the Optics Expansion Kit for use.

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c. Combination 1.2 m Track/Optics Bench, ORDER CODE TRACK, $119*

The Combination Dynamics Track/Optics Bench is black anodized aluminum and includes a metric scale. Extremely rigid, this 1.2 meter track will not sag under use. The track includes two adjustable levelers.

*Additional shipping charges may apply.

a. Diffraction Apparatus, ORDER CODE DAK, $549

The Diffraction Apparatus lets students create, view, and measure diffraction and interference patterns. The included Red Diffraction Laser provides a clean monochromatic light source. High-precision slits with fully opaque blocking areas cast clear diffraction and interference patterns, ideal for quantitative analysis of intensity *vs.* position.

The High Sensitivity Light Sensor is mounted on a novel Linear Position Sensor, which uses a precision optical encoder to measure translation with better than a 50 micron resolution.

The Diffraction Apparatus requires a Combination 1.2 m Track/Optics Bench, individually or part of the Vernier Dynamics System. An optional green Diffraction Laser is also available, so that the effect of wavelength on the pattern can be measured.

MORE ONLINE – www.vernier.com/dak

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b. Green Diffraction Laser, ORDER CODE GDL-DAK, $250

The Green Diffraction Laser is an optional accessory for the Diffraction Apparatus.

MORE ONLINE – www.vernier.com/gdl-dak

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c. Polarizer/Analyzer Set, ORDER CODE PAK-OEK, $74

The Polarizer/Analyzer Set allows students to study light polarization, doing experiments such as Malus's law. The set consists of three adjustable linear polarizers, one of which includes attachment points for the Vernier Rotary Motion Sensor.

The Polarizer/Analyzer Set is used in *Physics with Vernier* experiments.

MORE ONLINE – www.vernier.com/pak-oek

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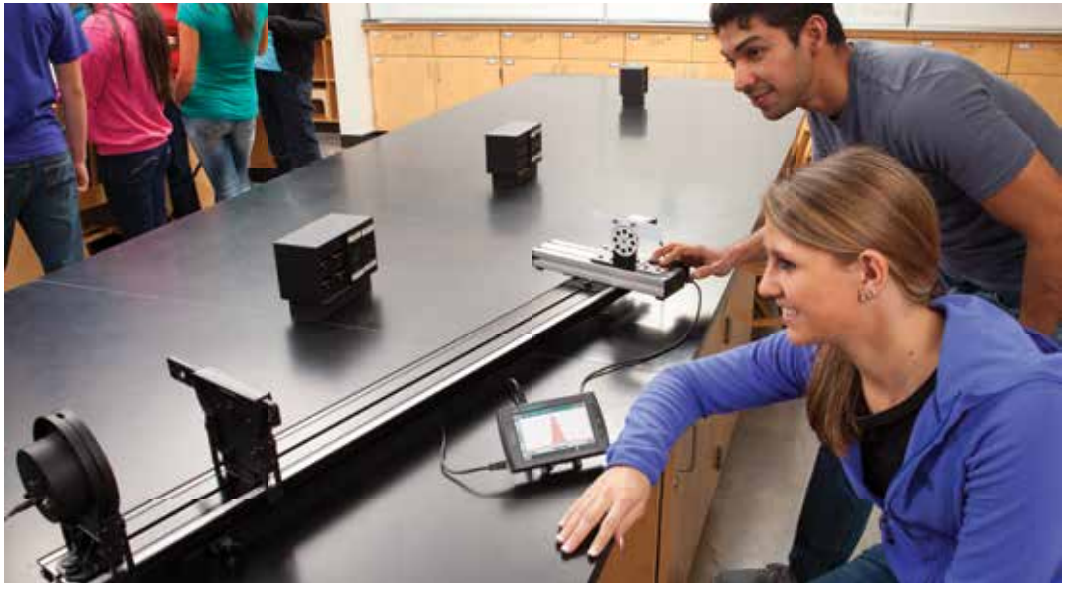
d. Color Mixer, ORDER CODE CM-OEK, $150

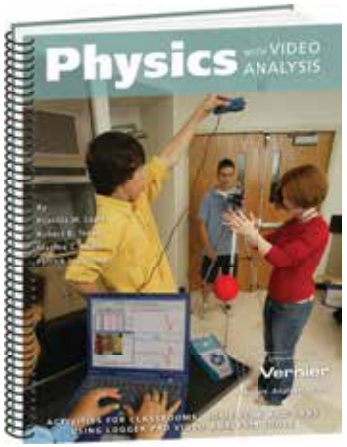
The Color Mixer accessory consists of a three-color LED source, a lens, and a screen. These all attach to a Vernier Track and can be used to study the mixing of red, blue, and green light by additive and subtractive mixing. These simple experiments show how modern computer and television displays work.

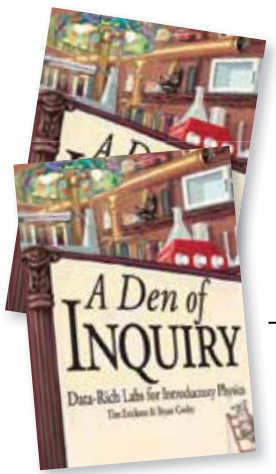
MORE ONLINE – Download a free sample experiment at **www.vernier.com/cm-oek**



Collecting intensity vs. position data for a diffraction pattern

$48 a





$40 b

$40 c

a. *Physics with Video Analysis*

ORDER CODE **PVA, $48**

by Priscilla Laws, Robert Teese, Maxine Willis, and Patrick Cooney

Physics with Video Analysis contains a wide selection of Logger *Pro* video analysis activities for introductory physics at either the high school or college level. Topics include kinematics, dynamics, circuits, sound, electrostatics, and more. Includes a CD with professionally made videos, student activities, solutions, and Logger *Pro* setup files.

MORE ONLINE – Free sample activities and videos are available on our website at **www.vernier.com/pva**

A Den of Inquiry *by Tim Erickson*

b. Volume 1, ORDER CODE DEN, $40

Fifteen labs for introductory physics. These labs emphasize data analysis and mathematical modeling, but they do not require sensors. The book includes files and instructions for Logger *Pro* and for Fathom®. Each lab includes teacher notes and black line masters.

c. Volume 2, ORDER CODE DEN2, $40

Sixteen sensor-based activities for introductory physics. Topics include kinematics, mechanics and energy; activities emphasize data analysis and modeling. Either Fathom 2.1 or Logger *Pro* software can be used.

Additional physics curriculum

For details on the following, go to **www.vernier.com/books** and click on Physics.

- Tools for Scientific Thinking
- RealTime Physics Activity Guides
- Workshop Physics
- Understanding Physics
- Interactive Lecture Demonstrations

VIDEO PHYSICS™

Vernier Video Physics brings video analysis to iPad®, iPhone®, and iPod touch®. Track an object automatically, set the scale, and see graphs of trajectory, position, and velocity. See page 32 for more information.

AWARDS of EXCELLENCE winner! TECH LEARNING

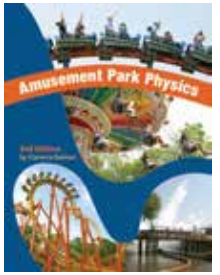
Download on the App Store

//CODiE// 2012 SIIA CODiE FINALIST

AMUSEMENT PARK PHYSICS *by Clarence Bakken*

ORDER CODE **AMPK, $35**

The book, *Amusement Park Physics*, is an excellent resource for teachers who want their students to connect their experiences at an amusement park to the physics concepts studied in class. The book explains how the instruments used to collect data, including electronic sensors, work on a conceptual level. A key portion of the book discusses taking your class to the amusement park and includes sample lab sheets and problem sets.



DATA VEST, ORDER CODE DV, $39

The Data Vest makes hands-free data collection at an amusement park or playground easy. The vest has a front pouch for the LabQuest, LabPro, CBL 2, or the Wireless Dynamics Sensor System. It has two inside pockets for the sensors and side straps to hold the vest in place.

ACTIVITY BASED PHYSICS HIGH SCHOOL *E*-DITION

ORDER CODE **ABP-E, $250, Download Only**

The *Activity Based Physics* High School e-dition is a special pre-college edition of physics curriculum from the Wiley Physics Suite, including *RealTime Physics*, *Workshop Physics*, and *Interactive Lecture Demonstrations*. See **www.vernier.com/abp-e**

A COMPLETELY WIRELESS SENSOR SYSTEM

The Wireless Dynamics Sensor System combines a 3-axis accelerometer, force sensor, and altimeter into one unit that communicates wirelessly with your computer via Bluetooth®. You can also use it as a standalone data logger. It's more than just a wireless sensor; it's a complete data-collection system completely free of friction due to cables. The Centripetal Force Apparatus (page 101) is significantly enhanced by using this wireless sensor.

Wireless Dynamics Sensor System

ORDER CODE **WDSS, $249**

Includes a rechargeable battery* and charger, bumpers for collisions, hooks for mounting the unit in different positions, mounting hardware for Vernier and other dynamics carts, and a manual.

* The battery carries a one-year warranty.

YOU ALSO NEED:

Computer use
- Logger *Pro* 3 software
- Either compatible built-in Bluetooth or Bluetooth USB Dongle

LabQuest use
- LabQuest 2
  or
- Original LabQuest with Bluetooth USB Dongle

Bluetooth USB Dongle Radio†

ORDER CODE **BLUE-USB, $35**

This convenient USB dongle adds Bluetooth capabilities to any original LabQuest and to any Windows XP SP2, Vista, Windows 7, or Mac OS X 10.4 or newer computer that lacks Bluetooth.

† Not for use with Go Wireless sensors

Wireless Dynamics Sensor System

Altimeter
Record changes in altitude for roller-coaster physics.

Multiple Mounting Options
Mount the device in almost any orientation using standard hardware.

Start/Stop Collection Button
Simple, one-button operation allows you to start and stop data collection when away from the computer.

Force Sensor
Custom load cell provides accurate, repeatable results.

3-Axis Accelerometer
Three orthogonally mounted sensors let you measure acceleration in all directions.

Data-Collection Status

Communication Status

On-Board Memory
Retains data even after the unit is turned off.

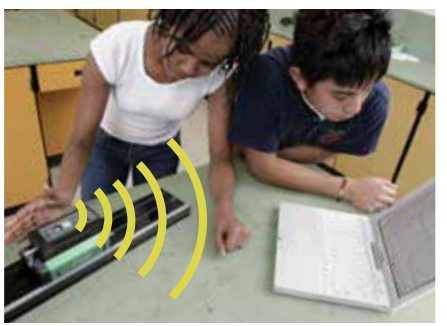
Battery Charging Indicator

Additional Hook
Allows the device to be mounted in-line for tension and pendulum experiments.

$249 ORDER CODE **WDSS**

- Measures acceleration, force, and altitude
- Wireless real-time data collection
- Works as a standalone data logger

WIRELESS DYNAMICS SENSOR SYSTEM
FORCE • ACCELERATION • ALTITUDE



SPECIFICATIONS
INTERNAL DATA STORAGE CAPACITY: 240,000 points
MAXIMUM SAMPLING RATE: 1000 samples/second

FORCE
RANGE: ±50 N
RESOLUTION: 0.006 N (<10 N)
0.03 N (>10 N)

ACCELEROMETERS *(FOR EACH AXIS)*
RANGE: ±60 m/s² (±6 g)
RESOLUTION: 0.04 m/s²

ALTIMETER
ALTITUDE CHANGE RANGE: ±200 m
RESOLUTION: 1 m

This wireless sensor is not compatible with mobile apps except when linked to a data sharing source. For more information about wireless sensors, see page 7.

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with Vernier lab books. Aligned to state and national science standards, our lab books contain experiments for LabQuest and computers.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 24–25.

3 CHOOSE YOUR SENSORS

Our Science Department Deluxe Package includes the most frequently used sensors for a variety of science courses to support your entire department.

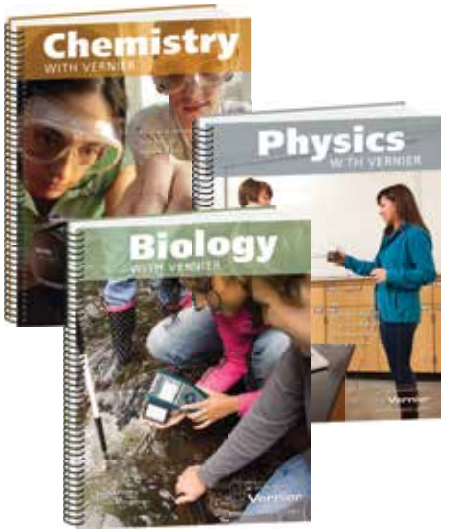
For a complete list of sensors by subject:

Biology page 37
Chemistry page 51
Earth Science page 67
Environmental Science page 79
Middle School Science page 89
Physical Science page 95
Physics pp. 99,101,103
Water Quality page 121

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.



SCIENCE LAB BOOKS

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive

- Essential teacher information
- Ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD, unless otherwise noted
- A generous site license—buy one book and duplicate labs for your class
- Editable labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/labs**

See pp. 122–131 for more information on all of our lab books.

VERNIER LAB BOOKS THAT USE PROBES INCLUDED IN OUR SCIENCE DEPARTMENT PACKAGES

	Stainless Steel Temperature Probe	Light Sensor	Voltage Probe	Motion Detector	Dual-Range Force Sensor	Microphone	Low-g Accelerometer	Magnetic Field Sensor	Gas Pressure Sensor	pH Sensor	Conductivity Probe	Colorimeter	Optical DO Probe	CO_2 Gas Sensor	Hand-Grip Heart Rate Monitor
Biology	✔								✔	✔	✔	✔	✔	✔	✔
Chemistry	✔		✔						✔	✔	✔	✔			
Earth Science	✔	✔	✔	✔				✔		✔	✔				
Environmental	✔	✔	✔							✔	✔		✔	✔	
Math	✔	✔	✔	✔	✔	✔			✔	✔					
Middle School	✔	✔	✔	✔	✔			✔	✔	✔	✔				✔
Physical Science	✔	✔	✔	✔	✔			✔	✔	✔	✔				
Physics	✔	✔	✔	✔	✔	✔	✔	✔							
Water Quality	✔									✔	✔	✔	✔		

For more information visit **www.vernier.com/probes**

WHY USE PROBEWARE IN SCIENCE?

Hands-on science using Vernier technology gets students excited about science and deepens their understanding of complex concepts. It gives students the tools to analyze data and think like real scientists. Request our **white paper** at **www.vernier.com/whitepaper**

Science Department LabQuest 2 and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

LabQuest 2

Standalone, Computer, or Tablet

LABQUEST 2 INTERFACE & SENSORS	CODE	Deluxe Package LQ2-SCI-ODX
Vernier LabQuest 2 Interface	**LABQ2**	$329
Stainless Steel Temperature Probe	TMP-BTA	$29
Light Sensor	LS-BTA	$55
Voltage Probe	VP-BTA	$12
Motion Detector	MD-BTD	$79
Dual-Range Force Sensor	DFS-BTA	$109
Microphone	MCA-BTA	$39
Low-g Accelerometer	LGA-BTA	$89
Magnetic Field Sensor	MG-BTA	$58
pH Sensor	PH-BTA	$79
Gas Pressure Sensor	GPS-BTA	$83
Conductivity Probe	CON-BTA	$95
Vernier Optical DO Probe	ODO-BTA	$389
Colorimeter	COL-BTA	$115
CO_2 Gas Sensor	CO2-BTA	$249
Hand-Grip Heart Rate Monitor	HGH-BTA	$119
PACKAGE PRICE		**$1,928**

DELUXE

YOU MAY ALSO NEED:

Lab books, see pp. 122–131.

Logger *Pro* 3 software, ORDER CODE **LP, $249**
See pp. 28–31.

LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79**
See page 23.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,870 EACH AND **SAVE $464!**

LabQuest Mini

Computer Only

LABQUEST MINI INTERFACE & SENSORS	CODE	Deluxe Package LM-SCI-ODX
Vernier LabQuest Mini Interface	**LQ-MINI**	$149
Stainless Steel Temperature Probe	TMP-BTA	$29
Light Sensor	LS-BTA	$55
Voltage Probe	VP-BTA	$12
Motion Detector	MD-BTD	$79
Dual-Range Force Sensor	DFS-BTA	$109
Microphone	MCA-BTA	$39
Low-g Accelerometer	LGA-BTA	$89
Magnetic Field Sensor	MG-BTA	$58
pH Sensor	PH-BTA	$79
Gas Pressure Sensor	GPS-BTA	$83
Conductivity Probe	CON-BTA	$95
Vernier Optical DO Probe	ODO-BTA	$389
Colorimeter	COL-BTA	$115
CO_2 Gas Sensor	CO2-BTA	$249
Hand-Grip Heart Rate Monitor	HGH-BTA	$119
PACKAGE PRICE		**$1,748**

DELUXE

YOU MAY ALSO NEED:

Lab books, see pp. 122–131.

Logger *Pro* 3 software, ORDER CODE **LP, $249**
See pp. 28–31 for details.

SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $1,696 EACH AND **SAVE $416!**

For TI calculator-based data collection, see pp. 132–137.

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest 2 – LabQuest 2 is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 17–23.

3 CHOOSE YOUR SENSORS

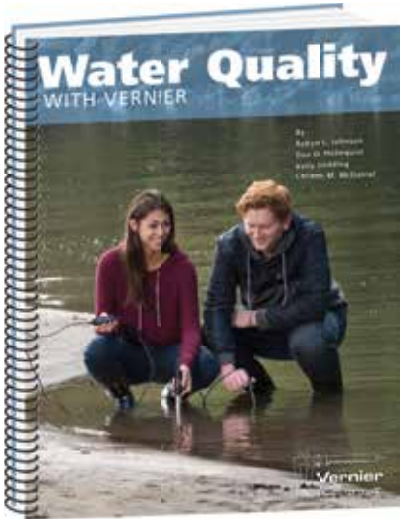
Build your own package by choosing from the list of sensors on the following page.

4 RECOMMENDED SOFTWARE

Logger *Pro* – This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 28–31 for details.

LabQuest Viewer – Project your LabQuest screen via Wi-Fi or remotely monitor student progress by viewing student LabQuests. More details on page 23.

Build custom packages online at www.vernier.com/guide



UPDATED WATER QUALITY LAB BOOK

$48 ORDER CODE **WQV** GREAT VALUE!

Updates include instructions for LabQuest Data Matrix mode and tests for new sensors. When you buy the lab book you will receive

- 18 ready-to-use student versions of LabQuest experiments in print; LabQuest, computer, and calculator versions on CD
- Essential teacher information
- A generous site license—buy one book and duplicate labs for your class
- Editable labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/wqv**

Did you know?

Shown with optional metal guard

Vernier Optical DO Probe, ORDER CODE **ODO-BTA, $389**

Students can now measure the concentration of dissolved oxygen in water quickly and easily with the Vernier Optical DO Probe. Use it to determine changes in dissolved oxygen levels, one of the primary indicators of the quality of an aquatic environment.

- Plug-and-play technology—no filling solution, warm-up time, calibration, or stirring necessary
- Built-in temperature and pressure compensation
- Easy maintenance
- Switch setting allows units of mg/L or % saturation
- Expanded range of 0–300% saturation
- Extended 2-year warranty on the ODO Cap

For more details, see page 47.

AP Many of the experiments in our water quality lab book are the perfect complement to labs for AP* Environmental Science. See **www.vernier.com/ap**

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GLOBE® AND VERNIER

Use Vernier sensors to collect GLOBE data! The following Verniers sensors have been approved by GLOBE:

- Barometer
- Relative Humidity Sensor
- Stainless Steel Temperature Probe
- Conductivity Probe
- Nitrate Ion-Selective Electrode
- Dissolved Oxygen Probe
- pH Sensor
- Turbidity Sensor
- Salinity Sensor
- Soil Moisture Sensor

To learn more about Vernier and GLOBE, see **www.vernier.com/globe**

Products for Water Quality Tests

WATER QUALITY LAB BOOK TEST	INTERFACE, SENSOR, AND ACCESSORY OPTIONS		ORDER CODE	PRICE	FEATURES
Needed for all tests		LabQuest 2 interface Vernier Lanyard	LABQ2 LQ-LAN	$329 $5	Use as a standalone device, connect to a computer, or wirelessly stream data to tablets and mobile devices. See pp. 17–23. Lanyard helps prevent LabQuest 2 damage by securing it around student's neck.
1 Temperature	CHOOSE ONE	Stainless Steel Temperature Probe	TMP-BTA	$29	Multi-purpose. Submersible to 10 cm.
		Extra-Long Temperature Probe	TPL-BTA	$79	Submersible to 30 m.
2 pH	CHOOSE ONE	pH Sensor	PH-BTA	$79	Multi-purpose. Glass bulb.
		Tris-Compatible Flat pH Sensor	FPH-BTA	$99	Flat glass. Double-junction electrode.
3 Turbidity		Turbidity Sensor	TRB-BTA	$112	
4 Total Solids		No Sensor Used			
5 Dissolved Oxygen		Optical DO Probe*	ODO-BTA	$389	
6 Biochemical Oxygen Demand		Optical DO Probe*	ODO-BTA	$389	
7 Phosphates	CHOOSE ONE	Colorimeter	COL-BTA	$115	Four wavelengths only.
		SpectroVis Plus	SVIS-PL	$469	Range of 380–900 nm.
8 Nitrate	CHOOSE ONE	Nitrate Ion-Selective Electrode	NO3-BTA	$179	Requires excellent chemical technique and frequent calibration.
		Colorimeter	COL-BTA	$115	Four wavelengths only.
		SpectroVis Plus	SVIS-PL	$469	Range of 380–900 nm.
9 Bacteria		No Sensor Used			
10 Ammonium Nitrogen		Ammonium Ion-Selective Electrode	NH4-BTA	$179	Requires excellent chemical technique and frequent calibration.
11 Alkalinity		pH Sensor of choice – see Test 2			
		Vernier Drop Counter (optional)	VDC-BTD	$99	Titration that requires drop counter or buret.
12 Total Dissolved Solids		Conductivity Probe	CON-BTA	$95	
13 Calcium and Water Hardness		Calcium Ion-Selective Electrode	CA-BTA	$179	Requires excellent chemical technique and frequent calibration.
14 Total Water Hardness		Vernier Drop Counter (optional)	VDC-BTD	$99	Titration that requires drop counter or buret.
15 Chloride and Salinity	CHOOSE ONE	Chloride Ion-Selective Electrode	CL-BTA	$179	Best for chloride content of fresh water. Requires excellent chemical technique.
		Conductivity Probe	CON-BTA	$95	Best for salinity of brackish water. Can be use with diluted ocean water.
		Salinity Probe	SAL-BTA	$99	Best for salinity of ocean water.
16 Stream Flow		Flow Rate Sensor	FLO-BTA	$129	
17 Physical Profile of a Lake	ALL FIVE PRODUCTS ARE USED	Conductivity Probe	CON-BTA	$95	
		pH Sensor of choice – see Test 2			
		Optical DO Probe*	ODO-BTA	$389	
		Temperature Probe of choice – see Test 1			
		Water Depth Sampler	WDS	$79	
18 PAR as a Function of Depth		PAR Sensor	PAR-BTA	$189	

YOU MAY ALSO NEED:

Water Quality with Vernier **lab book,** ORDER CODE **WQV, $48**

Logger *Pro* 3 software, ORDER CODE **LP, $249.** See pp. 28–31.

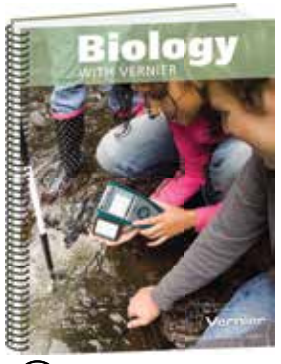
LabQuest Viewer software, ORDER CODE **LQ-VIEW, $79.** See page 23.

* Dissolved Oxygen Probe (DO-BTA) option available online

Enhance Your Curriculum with Vernier Lab Books

Buy just one copy per school, photocopy the labs, or print them from the included CD.

Each book includes a CD with word-processing files of the student instructions for data collection using Logger *Pro* (computer), LabQuest App (LabQuest as a standalone device), and EasyData (TI graphing calculators), unless otherwise noted.



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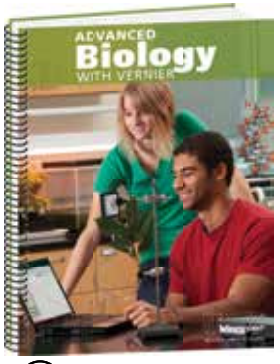

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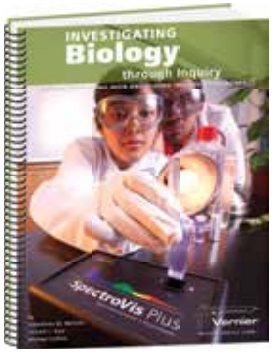

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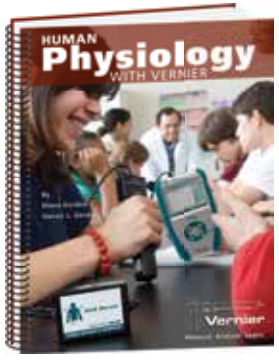

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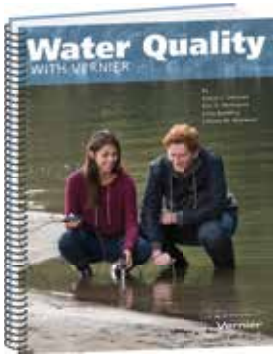

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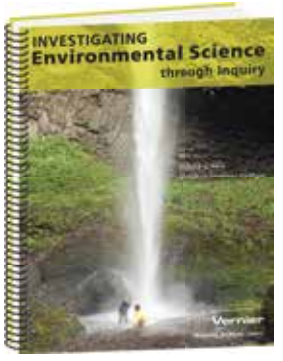

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a. *Biology with Vernier,* ORDER CODE **BWV, $48**
Highly recommended for first-year biology. This book contains 31 experiments in cell respiration, photosynthesis, membrane diffusion, osmosis, human physiology, transpiration, fermentation, and other important biology concepts. See page 36.

b. *Advanced Biology with Vernier,* ORDER CODE **BIO-A, $48**
Highly recommended for second-year or college biology. This book contains 17 experiments including the 12 traditional AP* Biology labs. Additional advanced-level experiments make it appropriate for introductory college biology courses, as well. See page 40.

c. *Investigating Biology through Inquiry,* ORDER CODE **BIO-I, $48**
Highly recommended for AP and IB† Biology.* This book, for data collection on computers and LabQuest only, will help you integrate inquiry into your high school or college biology curriculum. It provides many researchable questions for your students to investigate along with sample data for each investigation. See page 38.

d. *Human Physiology with Vernier,* ORDER CODE **HP-A, $48**
This book, for data collection on computers and LabQuest only, contains 24 human physiology experiments. The experiments are designed to encourage students to think about the physiology of various human organ systems. See page 44.

e. UPDATED *Water Quality with Vernier,* ORDER CODE **WQV, $48**
This book has been updated to take advantage of LabQuest's Data Matrix mode and recently developed sensors, including the Optical DO Probe and PAR Sensor. The 16 original tests are still available, including the nine used to determine the Water Quality Index (WQI). Two new investigations have been added. See page 120.

f. *Investigating Environmental Science through Inquiry,* ORDER CODE **ESI, $48**
Highly recommended for those teaching inquiry-based environmental science. This book contains 34 inquiry-based investigations. It covers issues that prompt students' interest in the effects of man-made environmental changes. Includes correlations for AP* and IB† environmental science. Student instructions are not platform specific. See page 78.

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†The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.

Did you know? You can customize the lab instructions on your LabQuest using My LabQuest Library. See page 130 for details.

a. *Chemistry with Vernier,* ORDER CODE **CWV, $48**
Highly recommended for first-year chemistry. This book contains 36 experiments in thermochemistry, gas laws, acid-base reactions, equilibrium, electrochemistry, electrolytes, states of matter, and more. See page 50.

b. NEW *Vernier Chemistry Investigations for Use with AP* Chemistry*
ORDER CODE **APCHEM, $48**
Highly recommended for AP Chemistry.* This book contains 16 inquiry investigations designed to support the AP Chemistry curriculum framework published by the College Board. See page 52.

c. *Investigating Chemistry through Inquiry,* ORDER CODE **CHEM-I, $48**
Highly recommended for IB† Chemistry. This book contains 25 inquiry-based chemistry investigations in thermochemistry, acids and bases, stoichiometry, chemical kinetics, and properties of solutions. See page 54.

d. *Advanced Chemistry with Vernier,* ORDER CODE **CHEM-A, $48**
This book contains 35 advanced chemistry experiments appropriate for second-year high school and college chemistry courses. Several experiments in this lab book can be used to supplement the AP Chemistry laboratory curriculum. See page 56.

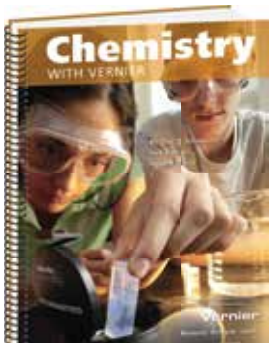
e. *Organic Chemistry with Vernier,* ORDER CODE **CHEM-O, $48**
Experiments in this book cover a broad range of topics, including compound identification, synthesis, chromatography, optical rotation, and spectroscopy for college organic chemistry courses. See page 58.

f. *Physics with Vernier,* ORDER CODE **PWV, $48**
Highly recommended for first-year physics. This book contains 35 experiments in mechanics, sound, light, electricity, and magnetism. See page 98.

g. *Advanced Physics with Vernier – Mechanics,* ORDER CODE **PHYS-AM, $48**
Recommended for second-year high school and college physics courses. This is the first of a two-volume set of experiments for the more in-depth introductory physics course. See page 100.

h. *Advanced Physics with Vernier – Beyond Mechanics*
ORDER CODE **PHYS-ABM, $48**
Highly recommended for advanced physics courses. This is the second of a two-volume set of new experiments for the more in-depth introductory physics course. Experiments are designed for an interactive teaching style. See page 102.

i. *Physics with Video Analysis,* ORDER CODE **PVA, $48**
This book contains a wide selection of video analysis activities using Logger *Pro* for introductory physics. See page 116.



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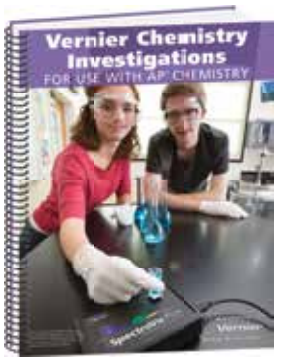

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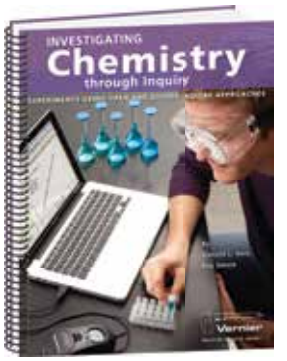

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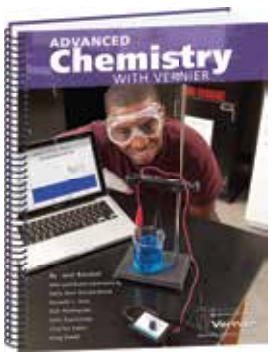

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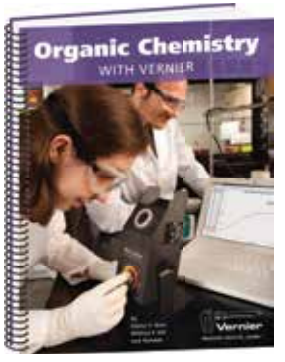

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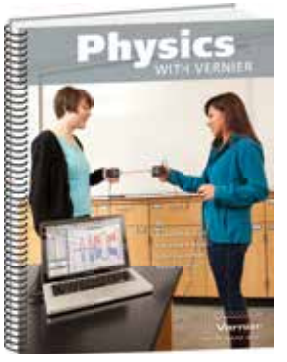

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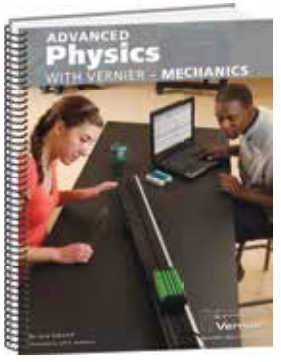

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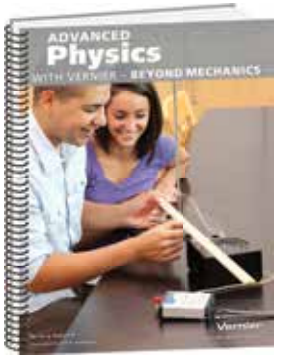

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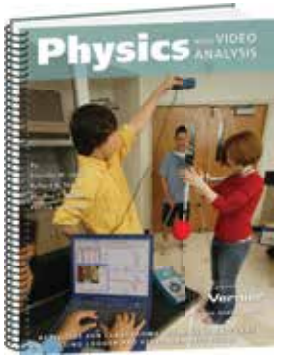

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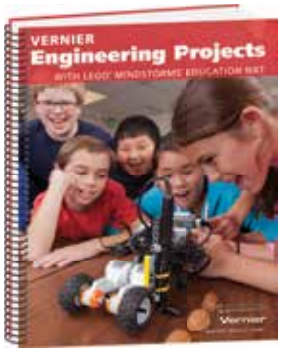

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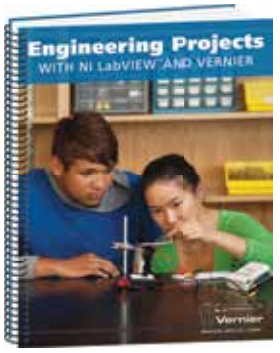

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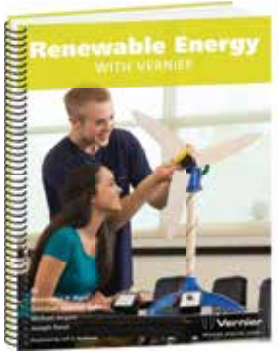

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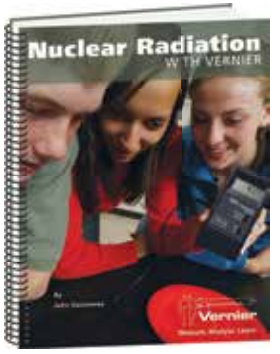

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a. NEW *Vernier Engineering Projects with LEGO® MINDSTORMS® EDUCATION NXT,* ORDER CODE **EP-NXT, $48**

This book contains 12 engineering challenges to build and program robots using the LEGO® MINDSTORMS® Education NXT Base Set, LEGO® MINDSTORMS® Education NXT Software version 2, and Vernier sensors. Not compatible with the EV3 system. See page 72.

b. *Engineering Projects with NI LabVIEW™ and Vernier,* ORDER CODE **EPV, $48**

This book includes 12 engaging, hands-on projects that introduce engineering concepts and programming with NI LabVIEW software and SensorDAQ, LabQuest, LabQuest 2, or LabQuest Mini. Topics include analog and digital input and output, feedback and control, servo and stepper motors, PID control, and pulse-width modulation. See page 76.

c. *Hands-On Introduction to NI LabVIEW™ with Vernier*
ORDER CODE **LWV, $25**

This book introduces NI LabVIEW programming through a series of hands-on exercises using Vernier sensors and SensorDAQ, LabQuest, LabQuest 2 or LabQuest Mini. See page 77.

d. NEW *Renewable Energy with Vernier,* ORDER CODE **REV, $48**

Perfect for teaching STEM, the *Renewable Energy with Vernier* lab book features 26 experiments in wind and solar energy. The lab book contains a combination of explorations, traditional experiments, inquiry investigations, engineering projects, and more. Written for and aligned to NGSS. This book is for data collection on computers and LabQuest only. See page 80.

e. *Real-World Math with Vernier,* ORDER CODE **RWV, $48**

This lab book contains 32 activities that explore real-world applications of math concepts from algebra through calculus. Activities cover topics such as linear, quadratic, and periodic functions, statistics, systems of equations, and many more. This book is for data collection on computers and calculators only. See page 135.

f. *Nuclear Radiation with Vernier,* ORDER CODE **NRV, $25**

This book contains six experiments for data collection with a radiation monitor including Distance and Radiation, Counting Statistics, Lifetime Measurement, Background Radiation Sources, Radiation Shielding, and Alpha, Beta, and Gamma. Suitable for both Physics and Chemistry courses.

a. *Middle School Science with Vernier,* ORDER CODE **MSV, $48**
This book is written specifically for students in grades 6–8. It contains 38 experiments in Earth science, life science, and physical science. See page 88.

b. *Forensics with Vernier,* ORDER CODE **FWV, $30**
This book is for teachers at the high school level who wish to introduce their students to forensics using engaging and realistic laboratory activities with Vernier probeware. The book contains 14 lab activities for computer and LabQuest only. See **www.vernier.com/fwv**

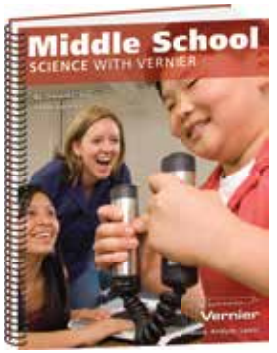
c. *Earth Science with Vernier,* ORDER CODE **ESV, $48**
This book contains 33 experiments and 6 projects. Topics include geology, soil analysis, water quality, hydrology, oceanography, meteorology, and energy. See page 66.

d. *Physical Science with Vernier,* ORDER CODE **PSV, $48**
This book contains 40 experiments for physical science (middle school through grade 10). These experiments are perfect for introductory physical science and integrated science classes. See page 94.

e. *Agricultural Science with Vernier,* ORDER CODE **AWV, $48**
This lab book contains experiments specifically chosen for teaching topics in agricultural science at the high school or college level. Experiments range from the investigation of factors affecting transpiration, to the temperature effect shearing has on sheep, to the development of an understanding of Ohm's law.

f. *Elementary Science with Vernier,* ORDER CODE **EWV, $48**
This book contains 43 fun and engaging experiments for elementary students. Activities investigate temperature, motion, force, magnetism, light, electricity, and pressure. This book is for data collection on computers and LabQuest only. See page 90.

g. NEW *Investigating Wind Energy,* ORDER CODE **ELB-WIND, $25**
This book contains 10 hands-on, engaging wind energy experiments for elementary students plus a culminating wind energy engineering project. Students explore wind energy through the use of KidWind MINI Wind Turbines and the Vernier Energy Sensor. Topics such as energy transfer, basic electric circuits, and blade variables, including pitch, shape, quantity, mass, and material, are covered. This book is for data collection on computers and LabQuest only. See page 92.



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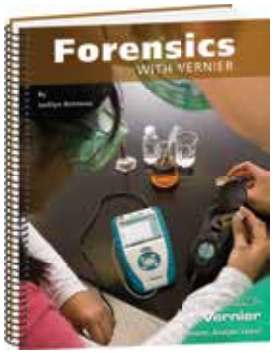

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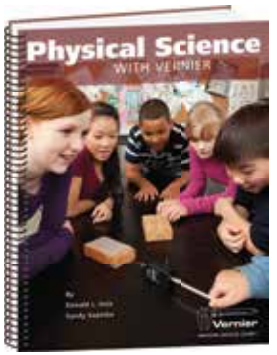
(c)



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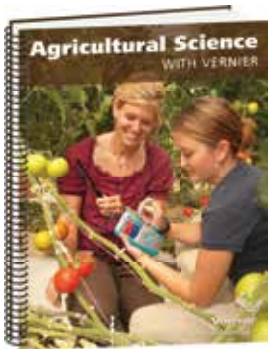

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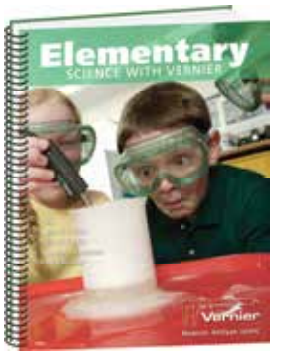

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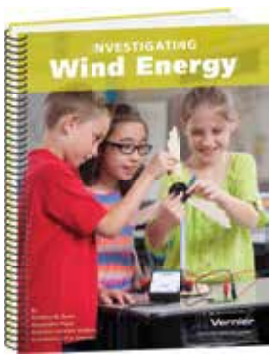
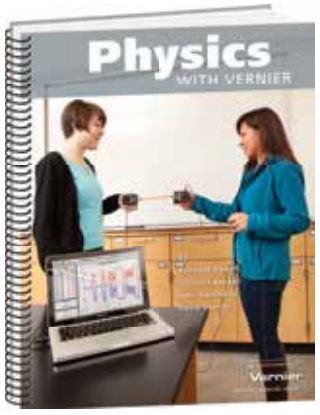
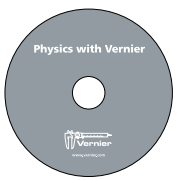


(g) NEW

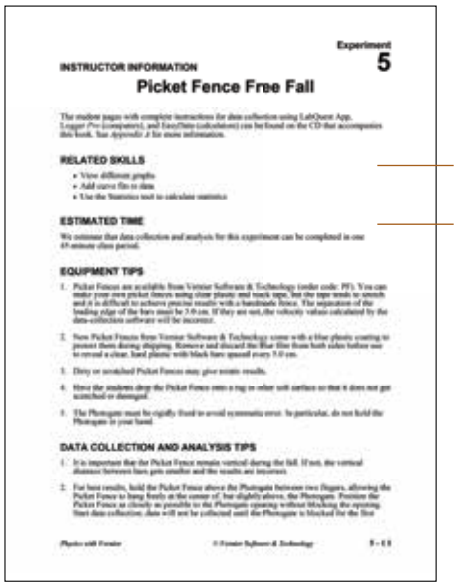
Lab Book Features

From the *Physics with Vernier* lab book





CD includes easy-to-edit Word files *for the student experiments, and instructions for LabQuest, computers, and calculators, unless otherwise noted*



Experiment **5**

INSTRUCTOR INFORMATION

Picket Fence Free Fall

RELATED SKILLS

ESTIMATED TIME

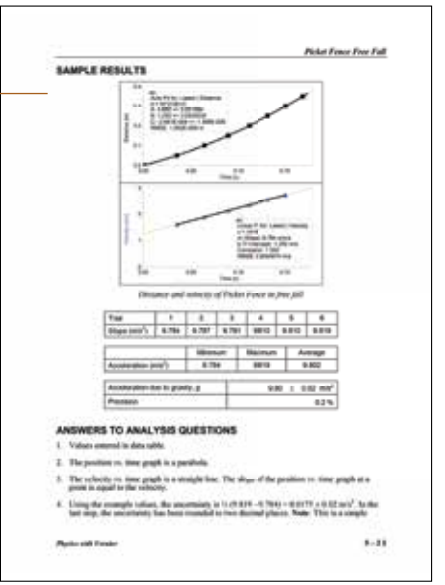
EQUIPMENT TIPS

DATA COLLECTION AND ANALYSIS TIPS

Sample data and graphs *let instructors see expected results*

Detailed teacher information *helps experiments run smoothly*

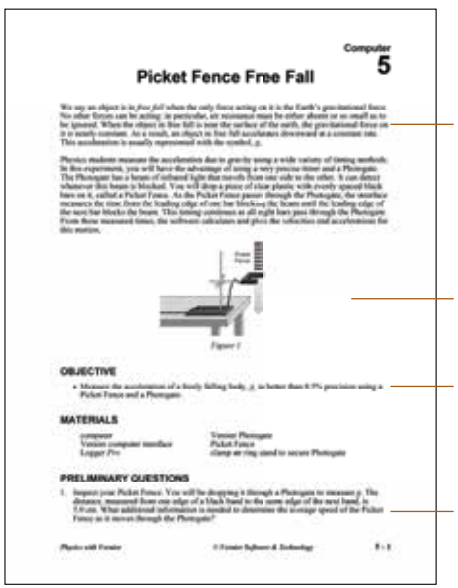
Time estimates *help with planning*



Picket Fence Free Fall

SAMPLE RESULTS

ANSWERS TO ANALYSIS QUESTIONS



Computer **5**

Picket Fence Free Fall

OBJECTIVE

MATERIALS

PRELIMINARY QUESTIONS

Background information *reinforces the scientific concepts behind the experiment and helps enrich the laboratory experience*

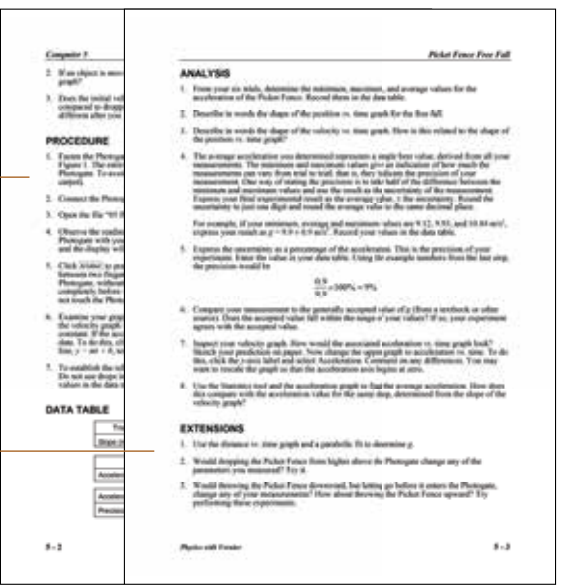
Procedures give ***detailed instructions***

Clear illustrations *help students visualize the experiment*

Concise objectives *specify desired student performance*

Extensions *provide suggestions for further investigation*

Preliminary questions *promote inquiry-based experiments*



Picket Fence Free Fall

PROCEDURE

DATA TABLE

ANALYSIS

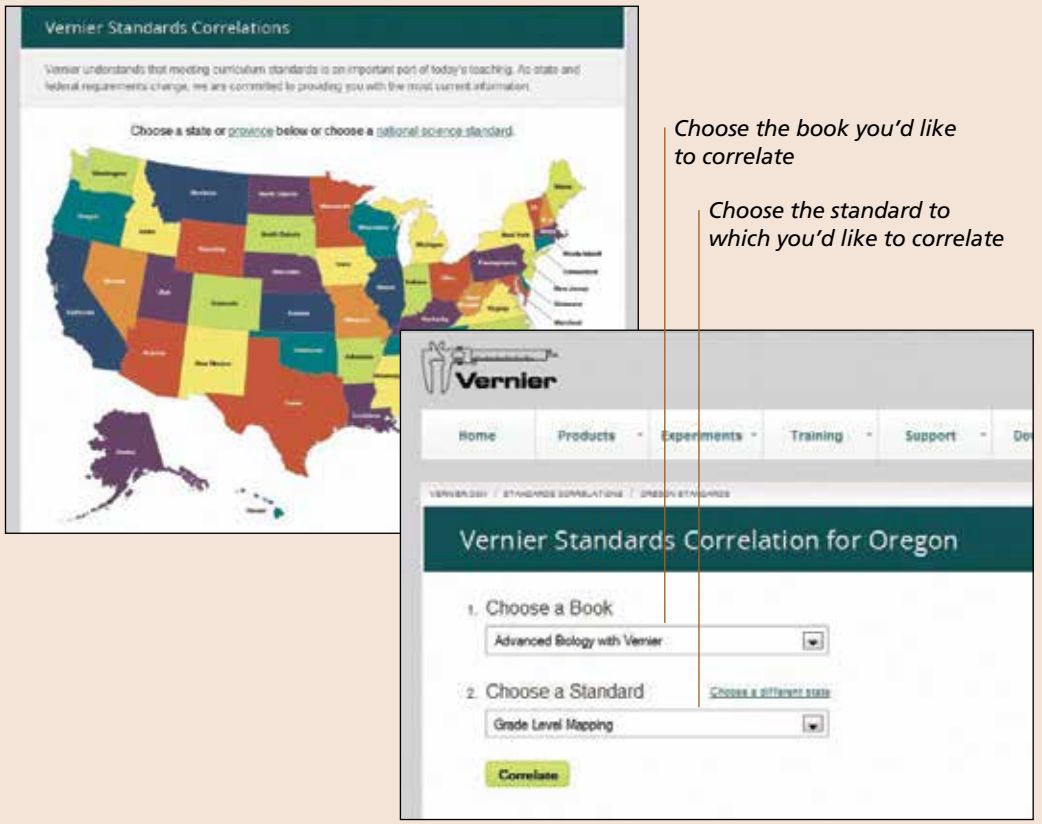
EXTENSIONS

Helping You Meet Content Standards

Vernier understands that meeting curriculum standards is an important part of today's teaching. As state and federal requirements change, we are committed to providing you with the most current information. You will find the following alignments to standards on our website for all lab books published by Vernier at **www.vernier.com/standards**

- Science standards for all 50 U.S. states
- Provincial standards for Canada
- NCTM (National Council for Teachers of Mathematics)
- AP and IB
- NSES (National Science Education Standards)
- ISTE (International Society for Technology Educators)

VERNIER STANDARDS CORRELATION FOR YOUR STATE



Choose the book you'd like to correlate

Choose the standard to which you'd like to correlate

MORE ONLINE – For more information, go to **www.vernier.com/standards**

VERNIER LAB BOOKS ARE A GREAT VALUE

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy a lab book, you will receive

- Essential teacher information
- Ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, LabQuest Mini, computer, and calculator versions on CD, unless otherwise noted
- A generous site license—buy one book and duplicate labs for your class.
- Editable labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD
- Suggested answers, sample data, and graphs
- Complete equipment and supplies list

The downloadable evaluation PDFs include student instructions only.

DOWNLOAD evaluation PDFs for all student experiments at **www.vernier.com/labs**

TRAINING VIDEOS ONLINE – Watch training videos and download free activities at **www.vernier.com/videos**

Next Generation Science Standards* and Vernier

Teach the next generation of scientists and engineers using Vernier technology

Vernier lab books encourage students to investigate natural phenomena and solve real-world problems that closely align with the eight science and engineering practices identified in the Next Generation Science Standards (NGSS). These science and engineering practices are the foundation of Vernier's lab books and include

- Asking Questions and Defining Problems
- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

Hands-on learning has been at the core of Vernier's mission for over 30 years, and as we create new products—whether it is hardware, software, or written investigations—we will work to align to NGSS, making it easy for teachers and science supervisors to help students meet these standards.

* Next Generation Science Standards is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards was involved in the production of, and does not endorse, these products.

WHY USE PROBEWARE?

To learn more about the research that links student use of probeware in the classroom to higher performance and test scores, download a copy of our white paper at

www.vernier.com/whitepaper

Vernier produces a number of lab books in alignment with the Next Generation Science Standards, and many of the experiments are designed to support students in three-dimensional learning. Applying these concepts in the classroom helps students make connections and develop the critical thinking skills required for success in the 21st century.

DEVELOPED FOR NGSS

Vernier's lab books are written specifically to correlate with NGSS Guidelines. Each lab book is loaded with teacher tips, sample graphs, and editable Microsoft® Word® versions of the student pages you can customize to use in your classroom.

- *Renewable Energy with Vernier* – recommended for high school
- *Investigating Wind Energy* – recommended for upper elementary school

INQUIRY-BASED LAB BOOKS

Vernier's inquiry-based lab books promote hands-on learning, reinforce science and engineering practices, and help students learn the 21st century skills promoted by NGSS. Many of these experiments help teachers directly address the three-dimensional learning recommended by the NGSS, including Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas.

- *Investigating Chemistry through Inquiry* – recommended for college and high school
- *Investigating Biology through Inquiry* – recommended for college and high school
- *Investigating Environmental Science through Inquiry* – recommended for high school

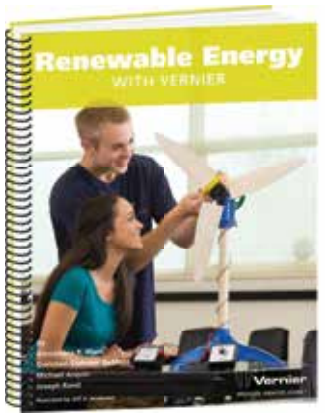
STEM ENGINEERING LAB BOOKS

Vernier also publishes a number of STEM-specific lab books with projects and activities that promote engineering education and cover topics such as mechanics, pressure, and electricity.

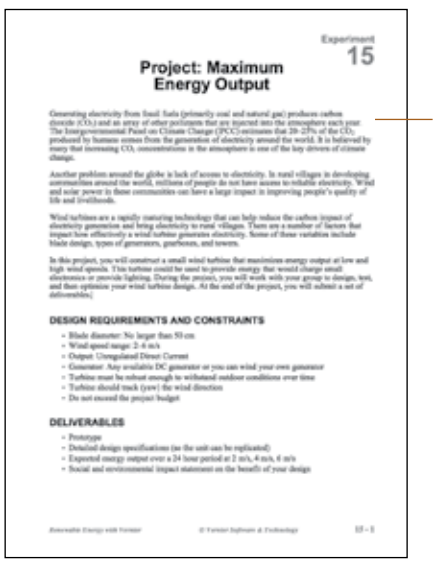
- *Vernier Engineering Projects with LEGO® MINDSTORMS® Education NXT*
- *Engineering Projects with NI LabVIEW and Vernier*
- STEM extensions for popular experiments **www.vernier.com/engineering/stem/extensions**

Lab Book Features

From the *Renewable Energy with Vernier* lab book



"Project: Maximum Energy Output" incorporates the Performance Expectations, Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas of NGSS.


Experiment 15

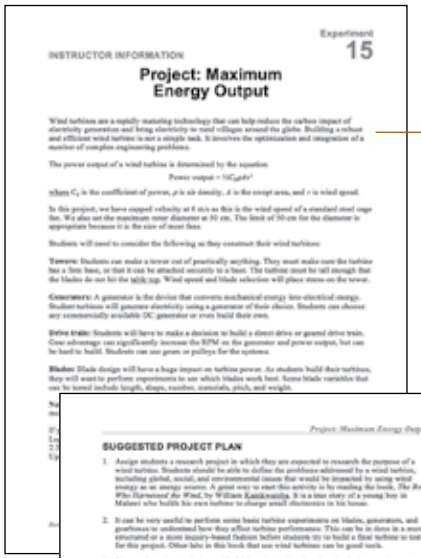
Project: Maximum Energy Output

DESIGN REQUIREMENTS AND CONSTRAINTS

DELIVERABLES

STUDENT PAGES

Global context *helps students make connections and identify real-world issues that link directly to the Science and Engineering Practices used in the experiment.*

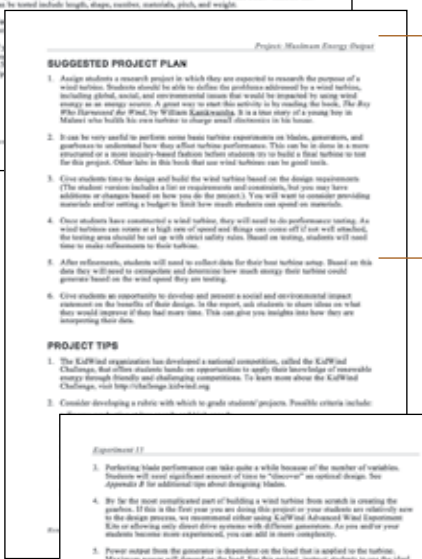

INSTRUCTOR INFORMATION

Experiment 15

Project: Maximum Energy Output

INSTRUCTOR INFORMATION

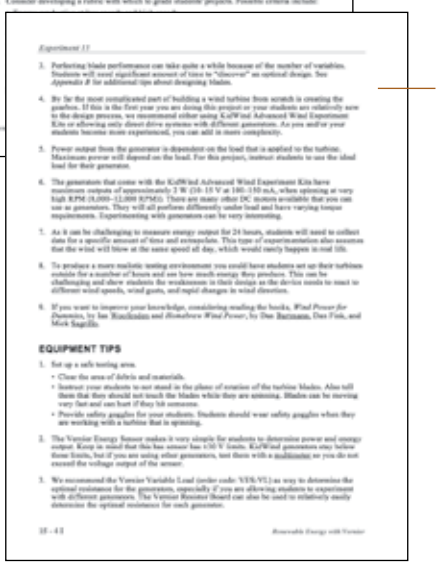
Detailed background information *helps a project run smoothly and reinforces scientific concepts.*


SUGGESTED PROJECT PLAN

PROJECT TIPS

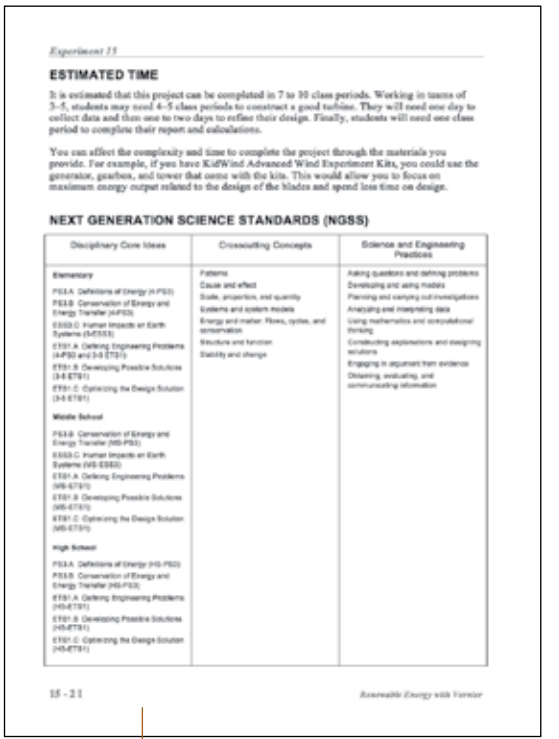
Data collection *using sensors allows students to test and refine projects using sensor data and the engineering design method.*

Suggested student reading *provides connections to ELA Common Core.*


EQUIPMENT TIPS

Equipment and safety tips *help comply with safety standards and give teachers helpful tips for working with the technology.*

EQuIP Rubric Friendly


ESTIMATED TIME

NEXT GENERATION SCIENCE STANDARDS (NGSS)

*Saves time when using the **EQuIP Rubric** to assess supplementary materials. **Each experiment shows connections to NGSS** Disciplinary Core Ideas, Science and Engineering Practices, and Crosscutting Concepts.*

My LabQuest Library

Vernier has embedded over 100 of our most popular science experiments into LabQuest. My LabQuest Library allows you to create, customize, organize, and download labs to LabQuest for the entire class.

www.vernier.com/mylabquest

LAB CREATOR

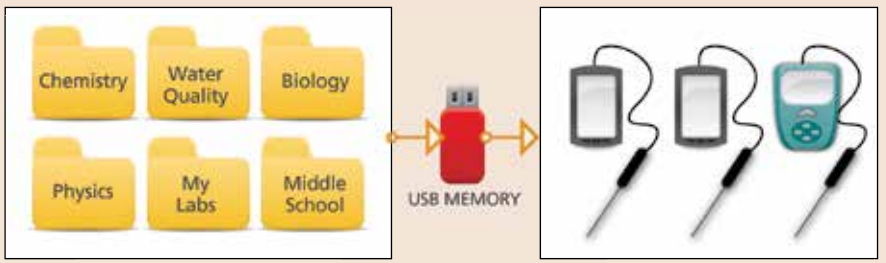
Create your own labs with the Lab Creator

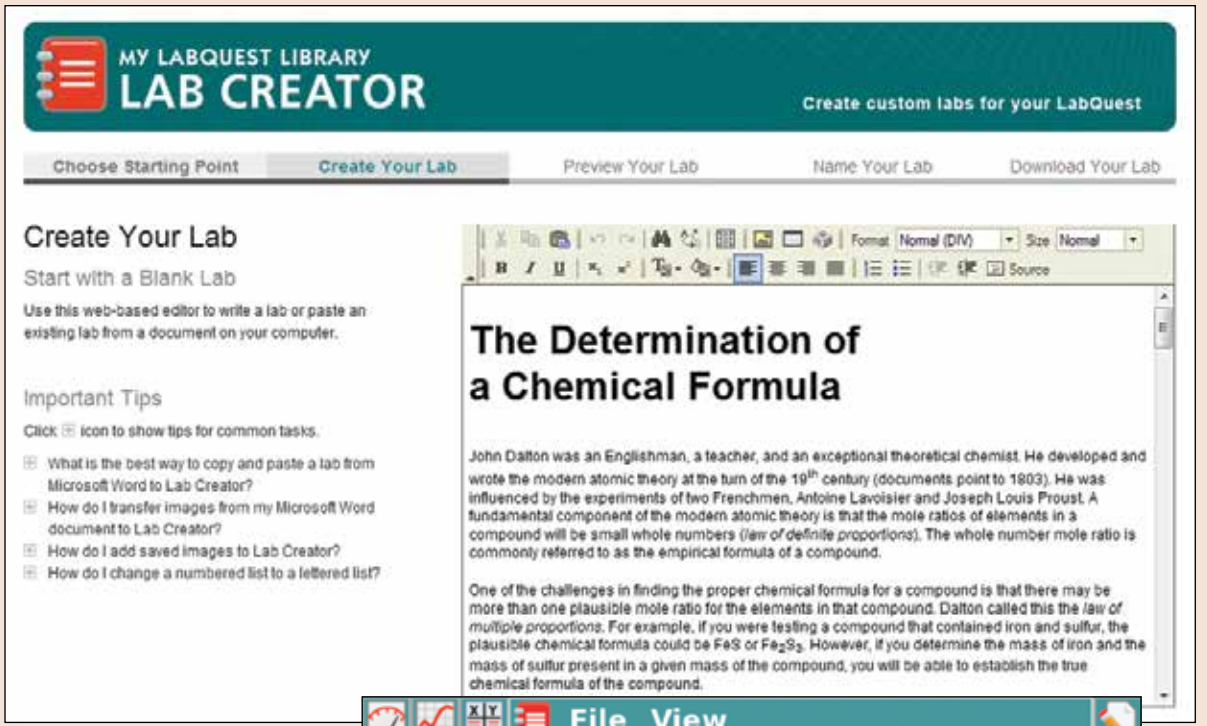
This **FREE** custom application allows you to create and easily upload your labs to LabQuest.

LAB ORGANIZER

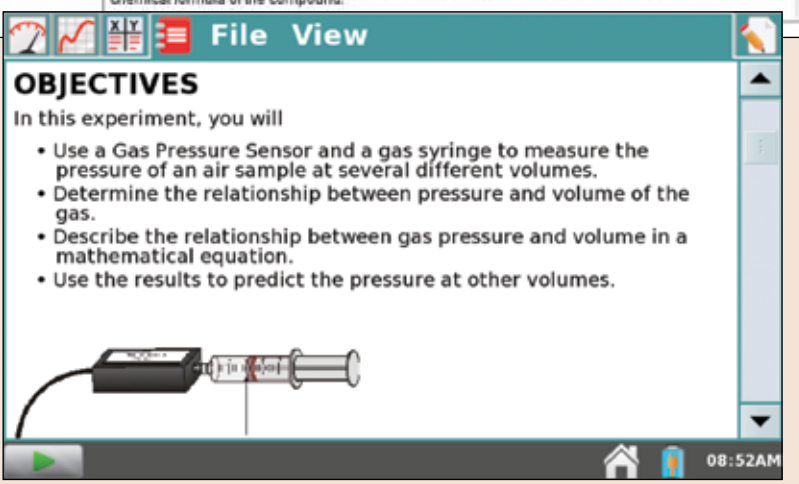
Customize your LabQuest with the Lab Organizer

In addition to our 100 most popular labs that are preloaded, more than 400 Vernier experiments from 16 lab books are available for you to upload to your LabQuest units!




MY LABQUEST LIBRARY
LAB CREATOR
Create custom labs for your LabQuest
Choose Starting Point
Create Your Lab
Preview Your Lab
Name Your Lab
Download Your Lab
Create Your Lab
Start with a Blank Lab
Use this web-based editor to write a lab or paste an existing lab from a document on your computer.
Important Tips
Click icon to show tips for common tasks.
What is the best way to copy and paste a lab from Microsoft Word to Lab Creator?
How do I transfer images from my Microsoft Word document to Lab Creator?
How do I add saved images to Lab Creator?
How do I change a numbered list to a lettered list?
The Determination of a Chemical Formula
John Dalton was an Englishman, a teacher, and an exceptional theoretical chemist. He developed and wrote the modern atomic theory at the turn of the 19th century (documents point to 1803). He was influenced by the experiments of two Frenchmen, Antoine Lavoisier and Joseph Louis Proust. A fundamental component of the modern atomic theory is that the mole ratios of elements in a compound will be small whole numbers (law of definite proportions). The whole number mole ratio is commonly referred to as the empirical formula of a compound.
One of the challenges in finding the proper chemical formula for a compound is that there may be more than one plausible mole ratio for the elements in that compound. Dalton called this the law of multiple proportions. For example, if you were testing a compound that contained iron and sulfur, the plausible chemical formula could be FeS or Fe2S3. However, if you determine the mass of iron and the mass of sulfur present in a given mass of the compound, you will be able to establish the true chemical formula of the compound.

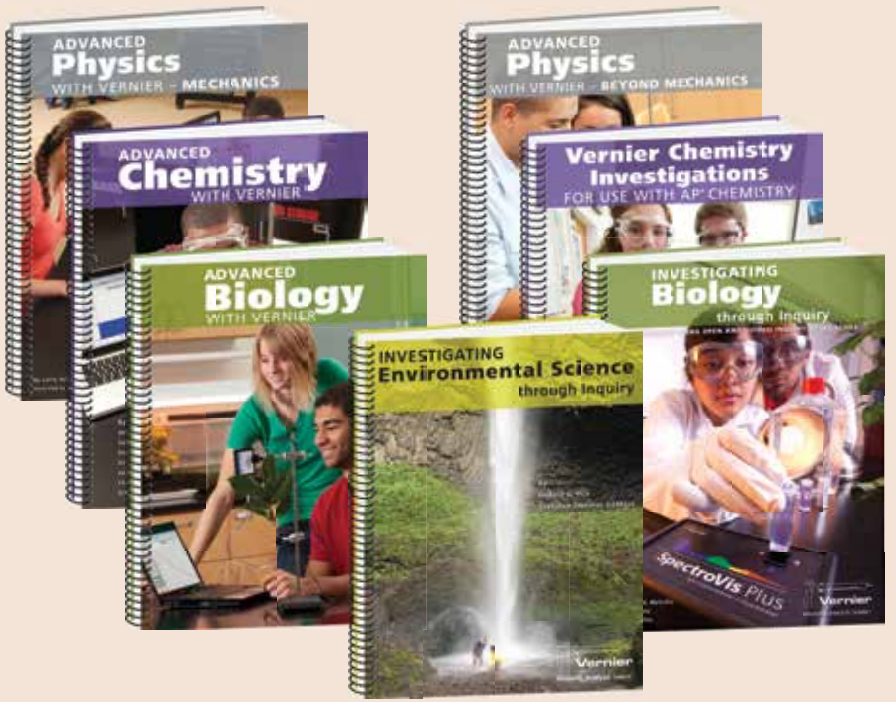
Create your custom lab with the Lab Creator.


File View
OBJECTIVES
In this experiment, you will
• Use a Gas Pressure Sensor and a gas syringe to measure the pressure of an air sample at several different volumes.
• Determine the relationship between pressure and volume of the gas.
• Describe the relationship between gas pressure and volume in a mathematical equation.
• Use the results to predict the pressure at other volumes.
08:52AM

Download it to your LabQuest.

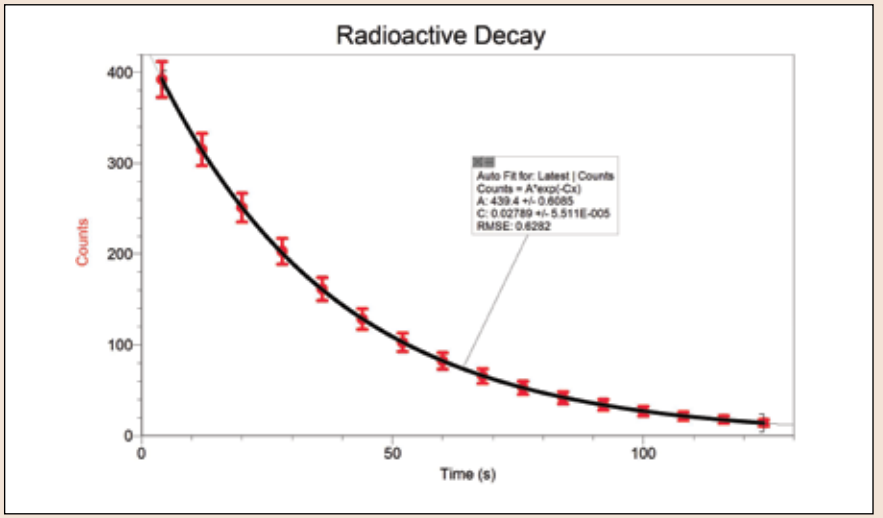
Your Complete Solution for AP* and IB† Science

CURRICULUM



- Correlations to AP and IB standards for biology, chemistry, physics, and environmental science
- Editable Microsoft® Word® files for all student pages, so you can customize the labs to meet your standards
- ICT support for the IB Group 4 sciences
- Questions promote higher-order thinking skills
- Lab extensions encourage inquiry investigations

SOFTWARE



Logger *Pro* 3, ORDER CODE **LP, $249,** One CD for Mac OS X and Windows

- Manual configuration mode allows students to set all data-collection parameters
- Error bars
- Log and semi-log graphs
- Modeling
- Custom curve fits
- Double y-graphs
- Gel analysis
- Peak integration on GC data
- Export data to Google™ Maps or GIS
- Spectrometer data analysis
- Video analysis

See pp. 28–31 for details.

IB Standards All IB Group 4 experimental science courses now require students to use sensors for data logging in an experiment and software for graph plotting. For IB correlations, visit **www.vernier.com/ib**

*AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.

†The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.

Additional information on data-collection packages for AP and IB science can be found on the following pages:

Biology – For Inquiry page 38, for AP/Advanced page 41
Chemistry – For AP page 53, for IB page 55
Physics – pp. 101, 103
Environmental Science – pp. 79, 120

TI-Nspire™ Technology for Math and Science

$135
ORDER CODE
TI-NSCX

$138
ORDER CODE
TI-NSCXCAS

Looking for training on Texas Instruments products? Go to **http://education.ti.com/us/pd**

TI-NSPIRE PRODUCTS

TI-Nspire CX Handheld, ORDER CODE **TI-NSCX, $135**
Includes TI-Nspire CX handheld, rechargeable battery, and AC wall adapter.

TI-Nspire CX Teacher Bundle, ORDER CODE **TI-NSCX-TB, $203**
Includes TI-Nspire CX handheld, rechargeable battery, AC adapter, and a single license of TI-Nspire Teacher Edition software.

TI-Nspire CX School Pack, ORDER CODE **TI-NSCX-TPK, $1,469**
Includes 10 TI-Nspire CX EZ Spot handhelds with the words "School Property" on the keypad, 10 rechargeable batteries, and a 10-unit docking station.

TI-Nspire Computer Software

TI-Nspire computer software and the TI-Nspire learning handheld share the same set of functionality, so you and your class can use either as a standalone learning tool.

Student Software, ORDER CODE **TI-NSSW-1, $72** (Single-user license)
Teacher Software, ORDER CODE **TI-N2T-SP-KT, $135** (Single-user license)
Teacher software includes license for both TI-Nspire and TI-Nspire CAS teacher software.
For multi-user licenses, go to **www.vernier.com/ti-nspire-licenses**

TI-NSPIRE CAS PRODUCTS

TI-Nspire CX CAS Handheld, ORDER CODE **TI-NSCXCAS, $138**
Includes a TI-Nspire CX CAS handheld, rechargeable battery, AC wall adapter.

TI-Nspire CX CAS Teacher Bundle, ORDER CODE **TI-NSCXCAS-TB, $206**
Includes TI-Nspire CX CAS handheld, rechargeable battery, AC adapter, and a single license of TI-Nspire CAS Teacher Edition software.

TI-Nspire CX CAS School Pack, ORDER CODE **TI-NSCXCAS-TPK, $1,499**
Includes 10 TI-Nspire CAS handhelds, 10 rechargeable batteries, and a 10-unit docking station.

TI-Nspire CAS Computer Software

TI-Nspire CAS Computer Software is designed for algebra through calculus. It contains Computer Algebra System functionality.

Student Software, ORDER CODE **TI-NSCASSW-1, $77** (Single-user license)
Teacher Software, ORDER CODE **TI-N2T-SP-KT, $135** (Single-user license)
Teacher software includes license for both TI-Nspire and TI-Nspire CAS teacher software.
For multi-user licenses, go to **www.vernier.com/ti-nspire-licenses**

CLASSROOM: *Investigate simulations that visualize hard-to-teach concepts*

LAB: *Fast and efficient data collection with Vernier sensors*

FIELD: *Extend learning beyond the classroom*

Data Collection with TI-Nspire™ Technology

TI-Nspire™ Lab Cradle, ORDER CODE **TI-NSLABC, $145**
The TI-Nspire Lab Cradle from Texas Instruments is a multi-channel, data-collection interface for use with TI-Nspire technology (sold separately). The Lab Cradle has five sensor ports for use with 68 Vernier sensors. Collect data up to 100,000 samples per second. The Lab Cradle is compatible with TI-Nspire computer software and handhelds running software version 3.0 or newer. The Lab Cradle includes a rechargeable battery and AC adapter.

TI-Nspire™ Lab Cradle Bundle, ORDER CODE **TI-NSLABC-5, $725**
Includes 5 TI-Nspire Lab Cradles with rechargeable batteries and a 5-unit charging bay.

$145

ORDER CODE
TI-NSLABC

TI-NSPIRE LAB CRADLE COMPATIBLE SENSORS

SENSOR	CODE	PRICE
Accelerometers		
3-Axis Accelerometer	3D-BTA	$99
25-g Accelerometer	ACC-BTA	$92
Low-g Accelerometer	LGA-BTA	$89
Anemometer	ANM-BTA	$89
Barometer	BAR-BTA	$71
Blood Pressure Sensor	BPS-BTA	$105
Charge Sensor	CRG-BTA	$75
CO_2 Gas Sensor	CO2-BTA	$249
IMPROVED Colorimeter	COL-BTA	$115
Conductivity Probe	CON-BTA	$95
Constant Current System	CCS-BTA	$59
Current Probes		
Current Probe	DCP-BTA	$39
High Current Sensor	HCS-BTA	$79
Diffraction Apparatus	DAK	$549
Dissolved Oxygen Probes		
Dissolved Oxygen Probe	DO-BTA	$209
Optical DO Probe	ODO-BTA	$389
Drop Counter	VDC-BTD	$99
Dual-Range Force Sensor	DFS-BTA	$109
EKG Sensor	EKG-BTA	$147
Electrode Amplifier	EA-BTA	$40
NEW Vernier Energy Sensor	VES-BTA	$69
Ethanol Sensor	ETH-BTA	$109
Flow Rate Sensor	FLO-BTA	$129

SENSOR	CODE	PRICE
Force Plate	FP-BTA	$245
Gas Pressure Sensor	GPS-BTA	$83
Goniometer	GNM-BTA	$159
Hand Dynamometer	HD-BTA	$99
Hand-Grip Heart Rate Monitor	HGH-BTA	$119
Instrumentation Amplifier	INA-BTA	$69
Ion-Selective Electrodes		
Ammonium Ion-Selective Electrode	NH4-BTA	$179
Calcium Ion-Selective Electrode	CA-BTA	$179
Chloride Ion-Selective Electrode	CL-BTA	$179
Nitrate Ion-Selective Electrode	NO3-BTA	$179
Potassium Ion-Selective Electrode	K-BTA	$179
Light Sensor	LS-BTA	$55
Magnetic Field Sensor	MG-BTA	$58
Melt Station	MLT-BTA	$469
Microphone	MCA-BTA	$39
Motion Detector	MD-BTD	$79
O_2 Gas Sensor	O2-BTA	$188
ORP Sensor	ORP-BTA	$79
PAR Sensor	PAR-BTA	$189
pH Sensor		
pH Sensor	PH-BTA	$79
pH Sensor, Tris-Compatible Flat	FPH-BTA	$99
Photogate	VPG-BTD	$45
Polarimeter (Chemical)	CHEM-POL	$499

SENSOR	CODE	PRICE
Projectile Launcher	VPL	$299
Pyranometer	PYR-BTA	$199
Radiation Monitor	VRM-BTD	$169
Relative Humidity Sensor	RH-BTA	$69
Respiration Monitor Belt (requires GPS-BTA)	RMB	$63
Rotary Motion Sensor	RMV-BTD	$169
Salinity Sensor	SAL-BTA	$99
Soil Moisture Sensor	SMS-BTA	$95
Sound Level Meter	SLM-BTA	$165
Spirometer	SPR-BTA	$199
Temperature Probes		
Extra-Long Temperature Probe	TPL-BTA	$79
Infrared Thermometer	IRT-BTA	$169
Stainless Steel Temperature Probe	TMP-BTA	$29
Surface Temperature Sensor	STS-BTA	$23
Thermocouple	TCA-BTA	$69
Wide-Range Temperature Probe	WRT-BTA	$79
Turbidity Sensor	TRB-BTA	$112
UV Sensors		
UVA Sensor	UVA-BTA	$106
UVB Sensor	UVB-BTA	$107
Voltage Probes		
Differential Voltage Probe	DVP-BTA	$39
Voltage Probe	VP-BTA	$12
30-Volt Voltage Probe	30V-BTA	$49

$129 a

$125 b

$108 c

TI-84 Plus Graphing Calculators

TI graphing calculators are valuable tools in math and science. We recommend the TI-84 or the TI-Nspire (see page 132) family of calculators. These calculators can be purchased individually or in convenient teacher packs of 10 calculators.

a. NEW TI-84 Plus CE, ORDER CODE TI-84PCE, $129
Available Spring 2015

Introducing the latest release of the popular TI-84 Plus family of graphing calculators! The TI-84 Plus CE, with its new slim design, has a full-color, high-resolution, backlit screen, making it easy to read. The calculator comes with a rechargeable battery, so there is never a need to buy AAA batteries. Import real-world images as a graph background for analysis of features found in the image. Use with Vernier EasyData 5.0 for data collection with 54 Vernier sensors to investigate concepts in math and science. The TI-84 Plus CE has the same menu structure, navigation and applications, making the transition from a TI-83/84 seamless.

Features include:
- New slim design
- High-resolution, backlit, full-color display
- Built-in rechargeable battery
- Import digital images (jpg, jpeg, bmp, and png)
- MathPrint™ option to see expressions as they appear in textbooks

Also available in a Teacher Pack of 10 handhelds that includes 10 EZ-Spot calculators and a 10-unit charging station.

TI-84 Plus CE Teacher Pack, ORDER CODE TI-84PCE-TPK, $1,345

b. TI-84 Plus C Silver Edition, ORDER CODE TI-84C, $125
- Original color-screen version of the TI-84 Plus
- Supports 66 Vernier sensors (when used with LabPro or CBL 2)
- Available while supplies last

TI-84 Plus C Teacher Pack, ORDER CODE TI-84C-TPK, $1,305

c. TI-84 Plus, ORDER CODE TI-84PL, $108
- A lower price alternative to the TI-84 Plus CE calculator
- Over ten preloaded Apps, including EasyData and Cabri™ Jr.
- Supports 66 Vernier sensors (when used with LabPro or CBL 2)

TI-84 EZ Spot Teacher Pack, ORDER CODE TI-84SPOTTP, $1,080

WHICH TI-84 CALCULATOR IS RIGHT FOR ME?

	TI-84 Plus CE	TI-84 Plus C Silver Edition	TI-84 Plus
New Sleek, Slim Design	✔		
Full-color, backlit display	✔	✔	
Rechargeable battery	✔	✔	
Expanded RAM Memory	✔		
Expanded Archive Memory	✔	✔	
Import photos & overlay graphs	✔	✔	
Data Collection Support			
EasyData App	v5.0	v4.0	v2.4
CBR 2 & EasyTemp	✔	✔	✔
EasyLink	✔	✔	✔
LabPro/CBL 2		✔	✔
Multiple sensors		✔	✔
Cost	$129	$125	$108

Exponential cooling curve

Math TI-Nspire Lab Cradle and EasyLink Packages

Purchase one package per group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

EasyLink

TI-Nspire Handhelds or TI-84 Plus calculators only

MORE ONLINE – For additional math package options, visit **www.vernier.com/products/packages/math**

EASYLINK INTERFACE & SENSORS	CODE	Starter Package MATH-EZ-STR	Deluxe Package MATH-EZ-DX
Vernier EasyLink Interface	**EZ-LINK**	$59	$59
CBR 2 – Motion Detector	CBR2	$99	$99
EasyTemp Temperature Probe	EZ-TMP	$38	$38
Gas Pressure Sensor	GPS-BTA	$83	$83
TI Light Probe	TILT-BTA	$13	$13
Voltage Probe	VP-BTA	$12	$12
pH Sensor	PH-BTA		$79
Dual-Range Force Sensor	DFS-BTA		$109
PACKAGE PRICE		**$304**	**$492**

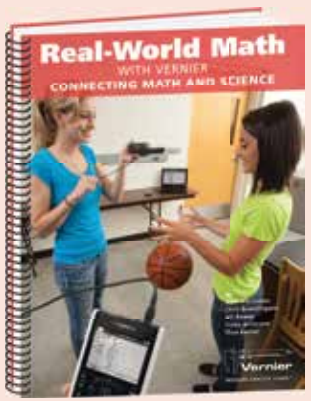
SPECIAL OFFER: BUY 8 DELUXE PACKAGES AT $481 EACH AND **SAVE $88!**

YOU WILL ALSO NEED:

Real-World Math with Vernier activity book ORDER CODE **RWV, $48** See previous page.

TI-Nspire Handheld see page 132 or **TI-84 Plus Calculator** see page 134.

For a complete list of compatible sensors, go to pp. 138–139 or **www.vernier.com/easylink**



REAL-WORLD MATH WITH VERNIER

ORDER CODE **RWV, $48** **Supports TI-Nspire, TI-84 Plus, TI-73, TI-89, and more!**

Real-World Math with Vernier: Connecting Math and Science activity book contains the following activities:

☐ **USING A MOTION DETECTOR**
- Straight Line Distance Graphs
- Newton's Second Law*†
- The Linear Force Relation for a Rubber Band*†
- Position and Time for a Cart on a Ramp
- Height and Time for a Bouncing Ball
- Definition of Rate
- Interpreting Velocity Graphs
- Applications of the Distance Formula
- Exponential Pattern of Rebound Heights
- Pendulum Motion
- Damped Harmonic Motion
- Describing Data With Statistical Plots
- Solving a System of Linear Equations
- Plotting an Ellipse
- Parametric Plots
- Piecewise-Defined Functions
- Greatest Integer Functions
- Period and Length of a Simple Pendulum

☐ **USING A LIGHT SENSOR**
- Distance and Intensity
- Periodic Phenomena*

☐ **USING A TEMPERATURE PROBE**
- Mixing Liquids of Different Temperatures
- How Hot Objects Cool
- Describing Data with Statistics*

☐ **USING A VOLTAGE PROBE**
- Exponential Models

☐ **USING A GAS PRESSURE SENSOR**
- Linear Relationship between Water Depth and Pressure
- Linear Rates of Pressure Increase
- The Inverse Relationship between Pressure and Volume

☐ **USING A MICROPHONE**
- Sound Waveform Models*

☐ **USING A FORCE SENSOR**
- Linear Relationship between Weight and Quantity
- Volume and Weight
- Newton's Second Law*
- The Linear Force Relation for a Rubber Band*

☐ **USING A pH SENSOR**
- The Exponential pH Change
- An Application of the Logistic Function

☐ STARTER PACKAGES ☐ DELUXE PACKAGES

* Experiment not supported by Easy Package † Requires Deluxe Package

$99 a

$59 b

$38 c

USB Devices for TI Calculators

We offer USB Sensors and interfaces that can be used with TI-84 Plus and TI-Nspire handhelds.

a. CBR 2, ORDER CODE **CBR2, $99**

If you teach math, physical science, or physics, consider the CBR 2. The CBR 2 collects distance, velocity, and acceleration data. It connects directly to a TI calculator. When the CBR 2 is connected to the USB port of a TI-84 Plus calculator or TI-Npsire handheld, the data-collection application automatically launches, and you are ready to collect data.

b. Vernier EasyLink, ORDER CODE **EZ-LINK, $59**

EasyLink is an easy, affordable way to get started with calculator-based data collection.

EasyLink is a single-channel interface that plugs into the USB port of a TI-84 Plus graphing calculator or TI-Nspire Handheld. It supports any one of over 50 Vernier sensors.

c. Vernier EasyTemp, ORDER CODE **EZ-TMP, $38**

EasyTemp is inexpensive and easy to use! What more can you ask for? Plug EasyTemp into the USB port on a TI-84 Plus calculator or TI-Nspire handheld. The data-collection application automatically launches, and you are ready to collect data! This stainless-steel probe is durable for classroom use and covers a temperature range of –20°C to 115°C.

Motion matching with a CBR 2

Collecting sensor data using EasyLink

CBL 2 ORDER CODE CBL2, $166

The CBL 2 System includes the CBL 2 interface, a Stainless Steel Temperature Probe, TI Light Probe, Voltage Probe, calculator cradle, link cable, batteries, and user's guide. Over 66 Vernier sensors can be used with the CBL 2.

The CBL 2 can be used with TI-73 Explorer, TI-83 Plus, TI-84 Plus, and TI-84 Plus C Silver Edition calculators. **It cannot be used with TI-84 Plus CE or TI-Nspire handhelds.**

For CBL 2 sensor packages for math, go to **www.vernier.com/products/packages/math**

Did you know?

Our Go Wireless® sensors, such as Go Wireless Temp (GW-TEMP, $75) and Go Wireless pH (GW-PH, $99), can be used with the TI-Nspire app for iPad®.

For more information about Vernier Go Wireless sensors, see page 10.

CALCULATOR PRODUCTS PRICE LIST

PRODUCT	CODE	PRICE
Calculators – TI-84 Plus		
TI-84 Plus CE *(available spring 2015)*	TI-84PCE	$129
TI-84 Plus CE Teacher Pack *(10 calculators & charging station)*	TI-84PCE-TPK	$1,345
TI-84 Plus Calculator	TI-84PL	$108
TI-84 Plus EZ Spot Teacher Pack	TI-84SPOTTP	$1,080
TI-84 Plus C Silver Edition Calculator *(while supplies last)*	TI-84C	$125
TI-84 Plus C Teacher Pack *(10 calculators & charging station)*	TI-84C-TPK	$1,305
Calculators – TI-Nspire		
TI-Nspire CX Handheld	TI-NSCX	$135
TI-Nspire CX Teacher Bundle *(handheld & TE software)*	TI-NSCX-TB	$203
TI-Nspire CX School Pack *(10 handhelds & docking station)*	TI-NSCX-TPK	$1,469
TI-Nspire CX CAS Handheld	TI-NSCXCAS	$138
TI-Nspire CX CAS Teacher Bundle *(handheld & TE software)*	TI-NSCXCAS-TB	$206
TI-Nspire CX CAS School Pack *(10 handhelds & docking station)*	TI-NSCXCAS-TPK	$1,499
Charging/Docking Stations		
TI-84 Plus C Charging Station	TI-84C-CS	$70
TI-84 Plus CE Charging Station	TI-84PCE-CS	$70
TI-Nspire CX Docking Station	TI-NSCX-DS	$120
Direct Connect USB Sensors		
EasyTemp	EZ-TMP	$38
Calculator-Based Ranger 2	CBR2	$99
Emulator/Computer Software		
TI SmartView Emulator software for TI-84 *(single-user license)*•	TI-SV	$135
TI-Nspire Student Computer Software *(single license)*•	TI-NSSW-1	$72
TI-Nspire CAS Student Computer Software *(single license)*•	TI-NSCASSW-1	$77
TI-Nspire Teacher Software *(single license numeric & CAS software)*•	TI-N2T-SP-KT	$135
Miscellaneous Accessories		
AC Adapter *(for LabPro, CBL 2, CBL)*	IPS	$12
Calculator-to-Calculator Link Cable	TI-CLC	$5
Short Calculator Link Cable	TI-SLC	$5
TI-84 Kickstand Slide Cover *(not for use with TI-84 Plus CE)*	TI-KSC	$10
TI USB Connectivity Kit	GLC-USB	$17
Real-World Math with Vernier lab book	RWV	$48
Sensor Interfaces		
CBL 2 System	CBL2	$166
Vernier EasyLink	EZ-LINK	$59
TI-Nspire Lab Cradle	TI-NSLABC	$145
TI-Nspire Lab Cradle Bundle *(includes 5-unit Charging Bay)*	TI-NSLABC-5	$725
TI Navigator System		
30-User TI-Nspire CX Navigator System°	TI-NAV-CX30	$2,550
15-User TI-Nspire CX Navigator System°	TI-NAV-CX15	$1,895
5-User TI-Nspire CX Navigator Add-on†°	TI-NAV-CX5	$380
TI-Nspire Navigator Teacher Software Add-on†•	TI-NAV-CXSW	$680
TI-Nspire Navigator for Network Computers**	TI-NAVNNC-SP-KT	$700

† Requires purchase of a Navigator system.
• Lower-price, multi-user license software also available. See **www.vernier.com/texas-instruments**
° Use with CX handhelds only, sold separately.
** Requires TI-Nspire / TI-Nspire CAS student software, sold separately.

TI products purchased in the USA are covered by a one-year warranty based on the date of purchase. Units are warranted against defective materials or workmanship.

TI-NAVIGATOR™ CLASSROOM LEARNING SYSTEMS

The TI-Navigator is a classroom learning system that combines Texas Instruments graphing technology and your classroom PC to create a wireless classroom network. Teachers can assess understanding of key concepts, monitor student progress, and differentiate instruction. The included software supports automatically grading and archiving student work. Learn more at **www.vernier.com/ti-navigator**

a. For TI-Nspire™ CX or TI-Nspire CX CAS Users**

30-User TI-Nspire CX Navigator System
ORDER CODE **TI-NAV-CX30, $2,550**

15-User TI-Nspire CX Navigator System
ORDER CODE **TI-NAV-CX15, $1,895**

5-User TI-Nspire CX Navigator Add-On‡
ORDER CODE **TI-NAV-CX5, $380**

TI-Nspire Navigator Teacher Software Add-On‡
ORDER CODE **TI-NAV-CXSW, $680**

** This system is for use with TI-Nspire CX handhelds only and will not work with older clickpad or touchpad units.
‡ Add-on pieces require the purchase of a 30-User or 15-User TI-Nspire Navigator system.

b. TI-Nspire Navigator for Networked Computers

ORDER CODE **TI-NAVNNC-SP-KT, $700**

Use with TI-Nspire / TI-Nspire CAS student software (not included).

c. TI-SmartView™ Emulator Software

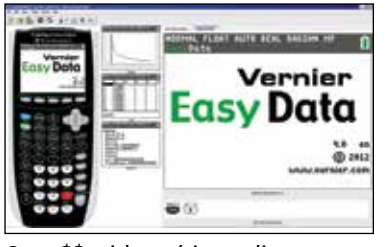
ORDER CODE **TI-SV, $135** *(Single-user license)*

TI-SmartView lets you project an interactive representation of a TI-84 Plus calculator to your entire class. You can use TI-SmartView to project multiple representations simultaneously (graphs, window settings, tables), display key press history, and capture multiple screenshots. For multi-user licenses of SmartView software, go to **www.vernier.com/ti-smartview**

a

b $700

c $135



Save $$ with multi-user licenses of SmartView software. See **www.vernier.com/ti-smartview**

The Vernier Sensor Advantage

OUTSTANDING PERFORMANCE

Vernier sensors are designed specifically for education and held to high standards for quality and durability. With 34 years of experience developing technology for education, we design our sensors for active, hands-on experiments. Vernier sensors are rugged, classroom-proven technology that are well supported and easy to use. The sensors provide consistent, high-quality results for the demands of the classroom.

CONNECT & COLLECT

Just connect and you're ready to collect. All Vernier sensors on the following pages are automatically detected and set up for data collection when used with Vernier software. It's student-friendly technology designed for ease of use.

GENEROUS WARRANTY

Buy with confidence. Most Vernier sensors are covered by a 5-year warranty. In Vernier's 34 years of business, we have rarely charged a customer for a repair, no matter how old the equipment.

INTERFACE-CONNECT SENSORS

Interface-connect sensors require additional hardware, called an interface. An interface includes a powerful data-acquisition processor to send sensor data to data-collection and analysis software. Most of our sensors are interface-connect so they will work on a variety of platforms, such as computers, tablets, or TI graphing calculators.

MORE INFORMATION ON SENSOR COMPATIBILITY

INTERFACE	MORE INFORMATION
LabQuest 2 (Standalone, computers, tablets)	Page 22
LabQuest Mini (Computers)	Page 25
Go Wireless Link (Tablets and other mobile devices)*	Page 10
Go!Link (Computers, Chromebooks)	Page 26
CBL 2 (TI Calculators)	www.vernier.com/cb2
TI-Lab Cradle (TI-Nspire technology)	Page 133
EasyLink (TI Calculators or TI-Nspire technology)	www.vernier.com/ez-link

USB SENSORS

USB Sensors connect directly to a computer or LabQuest 2, or, in some instances, with TI handhelds and calculators. No sensor interface is required. For more information on USB sensors see **www.vernier.com/usb-sensors**

WIRELESS SENSORS

Wireless sensors communicate directly with host devices (iPad, Android, LabQuest 2, for example, and, in some instances, computers) via Bluetooth communication. No sensor interface is required. For more information see **www.vernier.com/wireless-sensors**

*For sensor compatibility with the Go Wireless Link see **www.vernier.com/gw-link**

90 SENSORS AVAILABLE

SENSOR	CODE	PRICE	LABQUEST 2/ MINI	GO!LINK/ EASYLINK	USB OR WIRELESS	PAGE
Accelerometers						
3-Axis Accelerometer	3D-BTA	$99	✔			140
25-g Accelerometer	ACC-BTA	$92	✔	✔		140
Low-g Accelerometer	LGA-BTA	$89	✔	✔		140
Anemometer	ANM-BTA	$89	✔	✔		140
Barometer	BAR-BTA	$71	✔	✔		140
Blood Pressure Sensor	BPS-BTA	$105	✔	✔[1]		141
Charge Sensor	CRG-BTA	$75	✔	✔		141
CO_2 Gas Sensor	CO2-BTA	$249	✔	✔		141
IMPROVED Colorimeter	COL-BTA	$115	✔	✔		142
Conductivity Probe	CON-BTA	$95	✔	✔		142
Constant Current System	CCS-BTA	$59	✔	✔		142
Current Probes						
Current Probe	DCP-BTA	$39	✔	✔		143
High Current Sensor	HCS-BTA	$79	✔	✔		143
Diffraction Apparatus	DAK	$549	✔			115
Digital Control Unit	DCU-BTD	$61	✔[2]			143
Dissolved Oxygen Probes						
Dissolved Oxygen Probe	DO-BTA	$209	✔	✔		144
Vernier Optical DO Probe	ODO-BTA	$389	✔			144
Drop Counter	VDC-BTD	$99	✔			144
EKG Sensor	EKG-BTA	$147	✔	✔		144
Electrode Amplifiers						
Electrode Amplifier	EA-BTA	$40	✔	✔		145
NEW Go Wireless Electrode Amplifier	GW-EA	$79	✔[3]		*Wireless*[4]	145
NEW Energy Sensor	VES-BTA	$69	✔			145
Ethanol Sensor	ETH-BTA	$109	✔			145
Flow Rate Sensor	FLO-BTA	$129	✔	✔		146
Force Sensors						
Dual-Range Force Sensor	DFS-BTA	$109	✔	✔		146
Force Plate	FP-BTA	$245	✔	✔		146
NEW Structures & Materials Tester	VSMT	$999	✔	✔		147
Gas Pressure Sensor	GPS-BTA	$83	✔	✔		147
Goniometer	GNM-BTA	$159	✔	✔		147
Hand Dynamometer	HD-BTA	$99	✔	✔		148
Heart Rate Monitors						
NEW Go Wireless Heart Rate	GW-HR	$89	✔[3]		*Wireless*[4]	148
Hand-Grip Heart Rate Monitor	HGH-BTA	$119	✔	✔		148
Instrumentation Amplifier	INA-BTA	$69	✔	✔		148
Ion-Selective Electrodes						
Ammonium Ion-Selective Electrode	NH4-BTA	$179	✔	✔		149
Calcium Ion-Selective Electrode	CA-BTA	$179	✔	✔		149
Chloride Ion-Selective Electrode	CL-BTA	$179	✔	✔		149
Nitrate Ion-Selective Electrode	NO3-BTA	$179	✔	✔		149
Potassium Ion-Selective Electrode	K-BTA	$179	✔	✔		149

SENSOR	CODE	PRICE	LABQUEST 2/ MINI	GO!LINK/ EASYLINK	USB OR WIRELESS	PAGE
Light Sensor	LS-BTA	$55	✔	✔		149
Magnetic Field Sensor	MG-BTA	$58	✔	✔		149
Mass (Ohaus Balances)						
Scout Pro 0.01 g (200 g)	OHSP-202	$362	✔		*USB*	64
Scout Pro 0.01 g (400 g)	OHSP-402	$486	✔		*USB*	64
Scout Pro 0.001 g (120 g)	OHSP-123	$475	✔		*USB*	64
Melt Station	MLT-BTA	$469	✔	✔		150
Microphone	MCA-BTA	$39	✔			150
Mini GC Plus	GC2-MINI	$1,989	✔		*USB*	150
Motion Detectors						
Motion Detector	MD-BTD	$79	✔			151
Go!Motion	GO-MOT	$109	✔		*USB*	151
CBR 2 *(calculators only)*	CBR2	$99			*USB*[5]	136
Motion Encoder System – *see pp. 110–112*			✔			151
NODE Wireless Sensors					*Wireless*	13
O_2 Gas Sensor	O2-BTA	$188	✔	✔		151
ORP Sensor	ORP-BTA	$79	✔	✔		152
PAR Sensor	PAR-BTA	$189	✔	✔		152
pH Sensors						
NEW Go Wireless pH	GW-PH	$99	✔[3]		*Wireless*[4]	152
pH Sensor	PH-BTA	$79	✔	✔		153
pH Sensor, Tris-Compatible Flat	FPH-BTA	$99	✔	✔		153
Photogate	VPG-BTD	$45	✔			153
Polarimeter (Chemical)	CHEM-POL	$499	✔			154
Power Amplifier	PAMP	$199	✔			154
Projectile Launcher	VPL	$299	✔			113
Pyranometer	PYR-BTA	$199	✔	✔		154
Radiation Monitor	VRM-BTD	$169	✔			155
Relative Humidity Sensor	RH-BTA	$69	✔	✔		155
Respiration Monitor Belt *(requires GPS-BTA)*	RMB	$63	✔	✔		155
Rotary Motion Sensor	RMV-BTD	$169	✔			156
Salinity Sensor	SAL-BTA	$99	✔	✔		156
Soil Moisture Sensor	SMS-BTA	$95	✔	✔		156
Sound Level Meter	SLM-BTA	$165	✔	✔		157
Spectrometers						
SpectroVis Plus Spectrophotometer	SVIS-PL	$469	✔		*USB*	157
Vernier Emissions Spectrometer	VSP-EM	$799	✔		*USB*	157
Vernier UV-VIS Spectrophotometer	VSP-UV	$1,999	✔		*USB*	158
Ocean Optics Spectrometers						
Vernier Spectrometer	V-SPEC	$1,499	✔		*USB*	62
Spirometer	SPR-BTA	$199	✔	✔		158
Temperature Probes						
EasyTemp *(calculators only)*	EZ-TMP	$38			*USB*[5]	136
Extra-Long Temperature Probe	TPL-BTA	$79	✔	✔		159
Go!Temp	GO-TEMP	$39	✔		*USB*	159
Go Wireless Temp	GW-TEMP	$75	✔[6]		*Wireless*[4]	159
Infrared Thermometer	IRT-BTA	$169	✔	✔		159
Stainless Steel Temperature Probe	TMP-BTA	$29	✔	✔		159
Surface Temperature Sensor	STS-BTA	$23	✔	✔		159
Thermocouple	TCA-BTA	$69	✔	✔		160
Wide-Range Temperature Probe	WRT-BTA	$79	✔	✔		160
Turbidity Sensor	TRB-BTA	$112	✔	✔		160
UV Sensors						
UVA Sensor	UVA-BTA	$106	✔	✔		161
UVB Sensor	UVB-BTA	$107	✔	✔		161
Voltage Probes						
Differential Voltage Probe	DVP-BTA	$39	✔	✔		161
Voltage Probe	VP-BTA	$12	✔	✔		161
30-Volt Voltage Probe	30V-BTA	$49	✔	✔		161
Watts Up Pro	WU-PRO	$145	✔		*USB*	162
Wireless Dynamics Sensor System	WDSS	$249	✔		*Wireless*[6]	162

[1] With calculators, TI-Nspire only [2] With computers only [3] With LabQuest 2 only [4] Requires Bluetooth Smart support
[5] Mini-USB connectors for use with calculators [6] Not for use with tablets

Accelerometers

3-Axis, Low-g and 25-g

We have three accelerometers designed for different uses. These small devices can be mounted on objects to study motion. All are individually calibrated.

3-Axis Accelerometer

ORDER CODE **3D-BTA, $99**

Use this for studying the complex motion of an amusement park ride, a bungee jump, or simply a toss in the air.

RANGE: -50 to +50 m/s^2 **TYPICAL ACCURACY:** ±0.1 m/s^2

Low-g Accelerometer, ORDER CODE LGA-BTA, $89

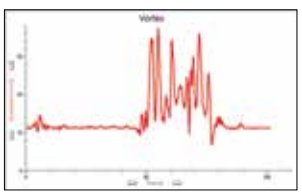
This is the best choice for most experiments. Use it for studying the one-dimensional motion of a car (real and toy), elevator, pendulum bob, or amusement park ride.

RANGE: -50 to +50 m/s^2 **TYPICAL ACCURACY:** ±0.1 m/s^2

25-g Accelerometer, ORDER CODE ACC-BTA, $92

Choose this for studying one-dimensional collisions or any motion with larger accelerations.

RANGE: -250 to +250 m/s^2 **TYPICAL ACCURACY:** ±1 m/s^2



Accelerations during the Vortex amusement park ride

See also WDSS on page 162.

GREAT WAYS TO USE THESE SENSORS!

PHYSICS
- Bungee jump accelerations
- Newton's second law
- Centripetal acceleration on a turntable
- Acceleration on a merry-go-round

HUMAN PHYSIOLOGY
- Neuromuscular reflexes

INNOVATIVE USES
- Accelerations on the half pipe
- Accelerations in snowboarding

Anemometer

$89 ORDER CODE ANM-BTA

The Vernier Anemometer is an impeller-type anemometer that measures wind speed in the range of 0.5 to 30 m/s (1 to 67 mph). The Anemometer fits in your palm for wind study measurements in the field. A standard camera mount on the back and an accessory rod allows you to position it in wind tunnels or in front of fans for wind turbine experiments.

RANGE: 0.5 m/s to 30 m/s

RESOLUTION:
10-bit resolution (using CBL 2): 4.8 x 10^{-2} m/s
12-bit resolution (using LabQuest, LabQuest Mini, LabPro, Go!Link, EasyLink): 1.2 x 10^{-2} m/s

Using the Anemometer to measure wind speed

GREAT WAYS TO USE THIS SENSOR!

ENVIRONMENTAL SCIENCE
- Measure the wind speed of air
- Measure the effects of design on wind turbine's output
- Measure the effects on cooling rate
- Measure wind speed in wind tunnels
- Use with a compass to determine wind direction
- Investigate wind speed over land and water

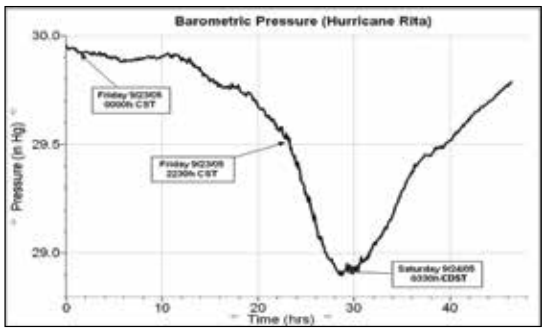
Barometer

$71 ORDER CODE BAR-BTA

Our Barometer can be used for weather studies or for lab experiments involving pressures close to normal air pressure.

RANGE: 77.98 to 105.29 kPa

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.008 kPa
10-bit (CBL, CBL 2, NXT Adapter): 0.03 kPa



Atmospheric pressure data collected during Hurricane Rita in 2005

GREAT WAYS TO USE THIS SENSOR!

EARTH SCIENCE
- Barometric pressure
- Local weather study

INNOVATIVE USES
- Study the barometric pressure of storms
- Use it as an altimeter
- Study Bernoulli's principle

Blood Pressure Sensor

$105 ORDER CODE BPS-BTA

The Blood Pressure Sensor is a non-invasive sensor designed to measure human blood pressure.

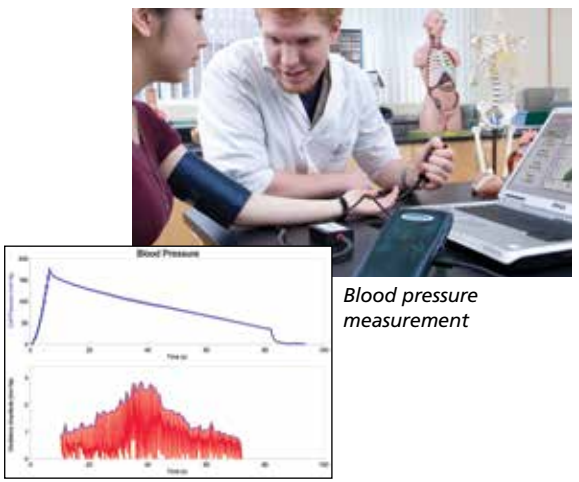
- Measures systolic and diastolic blood pressure utilizing the oscillometric technique.
- Includes a standard adult-size adjustable cuff (27 cm to 39 cm), pump bulb, and pressure transducer.

Additional cuff sizes are available for best results on small or large arms. Each includes cuff, pump, and valve.

Small Cuff, 18 cm to 27 cm, ORDER CODE **CUFF-SM, $32**
Large Cuff, 35 cm to 51 cm, ORDER CODE **CUFF-LG, $35**

PRESSURE RANGE: 0 mmHg to 250 mmHg

TYPICAL ACCURACY: ±3 mmHg



Blood pressure measurement

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Blood pressure as a vital sign
- Effect of exercise on blood pressure
- Diurnal blood pressure variation
- Heart rate and blood pressure as vital signs
- Heart rate, blood pressure, and exercise

Charge Sensor

$75 ORDER CODE CRG-BTA

Use the Charge Sensor as an electronic electroscope to obtain quantitative measurements when studying charging by induction, friction, or contact.

- A 0.01 µF input capacitor makes it possible for this extremely high impedance voltage sensor to be used in many electrostatic experiments.
- Range switch allows you to adjust sensitivity.
- Zero switch discharges the input capacitor between runs.

RANGES: ±0.5 V (± 5 nC)
±2 V (± 20 nC)
±10 V (± 100 nC)

Typical bias current: 0.005 pA
Input capacitance: 0.01 µF

Electrostatics Kit

ORDER CODE **ESK-CRG, $109**

The Electrostatics Kit is an accessory for the Charge Sensor. The kit includes a Faraday pail and cage, grounding plane, grounding wires and wrist strap, charge producers and proof plane, wool, vinyl, nylon rod, PVC rod, and a cotton cloth. See page 107.

High Voltage Electrostatics Kit

ORDER CODE **HVEK-CRG, $249**

This kit includes an electrostatics voltage source (output 750, 1500, 3000, 6000 V DC) and two conducting spheres. Extremely low output current makes this device safe for classroom use. See page 107.

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Use as electronic electroscope
- Charging by induction, by friction, and by contact
- Measure charge polarity

More innovative uses from teachers at **www.vernier.com/innovate**

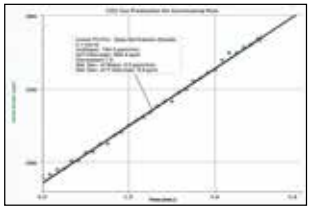
CO_2 Gas Sensor

$249 ORDER CODE CO2-BTA

The CO_2 Gas Sensor measures gaseous carbon dioxide in two ranges—0 to 10,000 ppm and 0 to 100,000 ppm.

- Explore human respiratory changes in CO_2 levels based on exercise with the high range.
- The lower range offers more sensitivity and a wider interval for cellular respiration and photosynthetic metabolism studies.

RANGE: Low 0–10,000 ppm
High 0–100,000 ppm



Measuring CO_2 levels of germinating peas

BioChambers

BioChambers provide a way for both CO_2 Gas and O_2 Gas Sensors, or one of these along with the Ethanol Sensor, to be used at the same time in a closed system.

BioChamber 2000, 2000 mL
ORDER CODE **BC-2000, $19**

BioChamber 250, 250 mL
ORDER CODE **BC-250, $6**

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Cell respiration in peas
- Respiration of sugars by yeast
- Effect of temperature on cold-blooded organisms
- Photosynthesis and respiration
- Levels of CO_2 in human respiration
- Measure CO_2 along with O_2 in respiration and photosynthesis

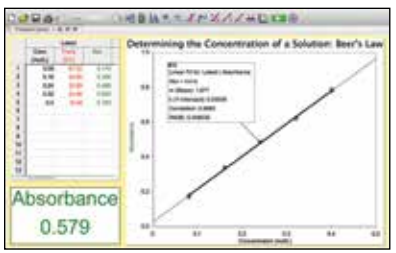
ENVIRONMENTAL SCIENCE
- Investigating indoor CO_2 concentrations

IMPROVED Colorimeter

$115 ORDER CODE COL-BTA

Our improved Colorimeter offers better protection against spills in the cuvette slot and accepts all standard 10 mm pathlength cuvettes. This 4-wavelength colorimeter features one-button automatic calibration. Fifteen 3.5 mL cuvettes are included. A package of 100 replacement cuvettes (with 20 lids) is available (ORDER CODE CUV, $15).

WAVELENGTHS: 430 nm 470 nm 565 nm 635 nm



Beer's law experiment

Cuvette Rack

ORDER CODE **CUV-RACK, $9**

No more spills! Holds ten standard cuvettes.

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Beer's law: determining the concentration of unknown substances
- Kinetics: rate and order of a chemical reaction
- Rate determination and activation energy
- Chemical equilibrium: Finding a constant, K_c
- Rate law determination of the crystal violet reaction

BIOLOGY
- Photosynthesis
- The effect of alcohol on biological membranes
- Population dynamics

WATER QUALITY
- Ortho- and total-phosphates concentration

FORENSICS
- Identifying an unknown ink by its light absorbance characteristics

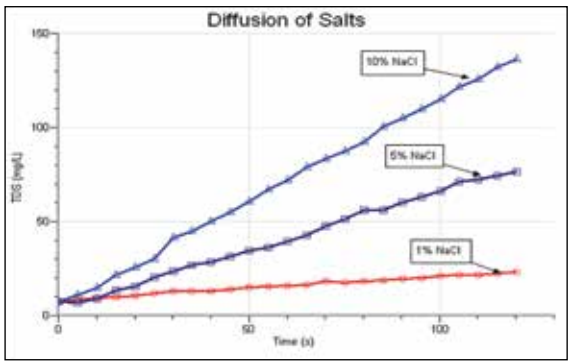
Conductivity Probe

$95 ORDER CODE CON-BTA

This probe measures the electrical conductivity of water. It is an important part of chemistry, biology, and water quality studies.

AUTOMATIC TEMPERATURE COMPENSATION: 5°C to 35°C

LOW RANGE:	MEDIUM RANGE:	HIGH RANGE:
0–200 µS/cm	0–2000 µS/cm	0–20000 µS/cm
(0–100 mg/L TDS)	(0–1000 mg/L TDS)	(0–10000 mg/L TDS)



Diffusion through membranes

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Diffusion of ions through membranes
- Monitor changes in ion levels in aquatic systems
- Limitations of cell size: surface area to volume

MIDDLE SCHOOL
- Water hardness study
- Diffusion: how fast?

CHEMISTRY
- Investigate ionic and molecular compounds, strong and weak acids
- Conductimetric titrations
- Investigate ionic concentrations and conductivity levels

WATER QUALITY
- Total dissolved solids

PHYSICAL SCIENCE
- Acid strengths

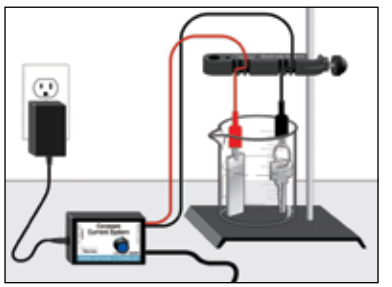
Constant Current System

$59 ORDER CODE CCS-BTA

The Constant Current System is a DC power source capable of delivering up to 0.6 A with a built-in current probe designed for use in electrochemistry experiments. The user can set the current by turning the dial with the system automatically adjusting the voltage.

Note: The Constant Current System works only with its own built-in power supply. It cannot be used to measure the current of a circuit using a different power supply.

RANGE: 0 to 0.6 A
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.18 mA



Electroplating a key

Electrode Support

ORDER CODE **ESUP, $10**

Our Electrode Support is a perfect holder for many sensors. With our improved design, you can suspend the wire leads for your electroplating setup.

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Electroplating
- Determining Avogadro's number

Current Probes

Current Probe

$39 ORDER CODE DCP-BTA

Use the Current Probe to measure currents in low-voltage AC and DC circuits. With a range of ±0.6 A, this probe is ideal for use in most battery and bulb circuits. Use multiple sensors to explore series and parallel circuits. It can also be used in electrochemistry experiments.

RANGE: -0.6 to +0.6 A **SENSE RESISTOR:** 0.1 Ω
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.3 mA
10-bit (CBL, CBL 2, NXT Adapter): 1.25 mA

Studying Ohm's law using the Current Probe, Differential Voltage Probe, and the Vernier Circuit Board

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Electroplating
- Determining Avogadro's number

ENVIRONMENTAL SCIENCE
- Solar energy: photovoltaic cells
- Wind energy

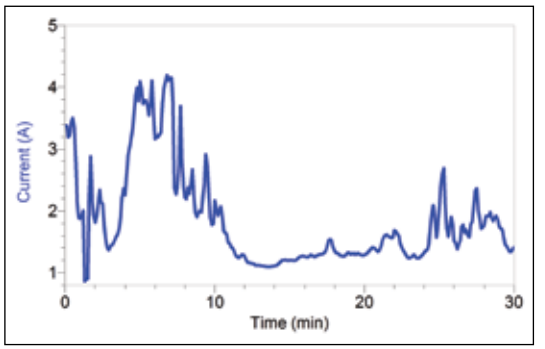
PHYSICS
- Ohm's law
- Series and parallel circuits
- Electrical energy

High Current Sensor

$79 ORDER CODE HCS-BTA

The High Current Sensor is used to measure current in the range of ±10 A. The sensor uses a Hall effect chip, so that it does not add a resistive element to your circuit. A metal shield over the Hall effect chip reduces the influence of external magnets. A replaceable fuse protects the equipment and circuit.

RANGE SETTINGS: 10 A; maximum voltage input 40 V
RESOLUTION:
12-bit resolution (LabQuest, LabQuest Mini, LabPro, Go!Link): 4.9 mA



Current draw from large solar panel on partially cloudy day

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Record currents from a solar panel
- Record currents from popular hand-held generators
- Record current in do-it-yourself projects with larger current, such as wind generators

Digital Control Unit

$61 ORDER CODE DCU-BTD

The Digital Control Unit (DCU), combined with new features in Logger *Pro*, makes control of electrical devices, such as buzzers, lights, motors, pumps, and relays, both straightforward and flexible. The DCU is a great way to introduce hands-on STEM and engineering projects.

Included is a manual that contains
- Project ideas using Logger *Pro*
- Explanations of how to write LabVIEW programs for the DCU and SensorDAQ or LabQuest
- Wiring diagrams

Using a Digital Control Unit to control an automated light tracker

DCU Power Supply, ORDER CODE **IPS, $12**

Note: The Digital Control Unit does not work with LabQuest app, but will work with LabQuest and Logger *Pro* 3.7, and newer.

NEW DCU Terminal Plug, ORDER CODE **DCU-PLUG, $39**

For more information on the DCU Terminal Plug see page 73.

GREAT WAYS TO USE THIS SENSOR!

ENGINEERING
- Turn on motors or buzzers
- Make an alarm system
- Make a robot
- Create temperature-controlled environments
- Moving displays
- Flash lamps on LEDs

Dissolved Oxygen Probes

Vernier Optical DO Probe

$389 ORDER CODE ODO-BTA

Now with a wider range, the Vernier Optical DO Probe makes it easy to measure the dissolved oxygen concentration in water. Perfect for the field or for the laboratory, this plug-and-play probe requires no calibration, no filling solution, no warm-up time, and no stirring.

See page 47 for accessories.

AUTOMATIC TEMPERATURE COMPENSATION: 5°C to 35°C

RANGE: 0 to 20 mg/L (or ppm), 0 to 300%

RESPONSE TIME: 90% of final reading in 40 seconds

TEMPERATURE COMPENSATION: automatic from 0 to 50°C

PRESSURE COMPENSATION: automatic from 228 mmHg to 1519 mmHg

MINIMUM SAMPLE FLOW: none

Dissolved Oxygen Probe

$209 ORDER CODE DO-BTA

For more information on the Dissolved Oxygen Probe, please visit our website at **www.vernier.com/do-bta**

GREAT WAYS TO USE THESE SENSORS!

BIOLOGY
- Interdependence of plants and animals
- Aerobic respiration
- Dissolved oxygen *vs.* time
- Watershed testing
- Physical profile of a lake
- Primary productivity

WATER QUALITY
- Dissolved oxygen concentration
- Biochemical oxygen demand (BOD)

ENVIRONMENTAL SCIENCE
- Long term water monitoring
- Investigating dissolved oxygen

Drop Counter

$99 ORDER CODE VDC-BTD

Use the Drop Counter with our pH Sensor, Conductivity Probe, or ORP Sensor to easily perform acid-base, conductimetric, or potentiometric titrations. The Vernier Drop Counter has many features that help simplify its use:

- Wide drop-detecting area
- Red LED, near the detecting area, flashes to indicate a drop has been recorded
- Accurate drop counting at rates up to 6 drops/second
- Adjustable clamp; fits most laboratory ring stands and lattices
- Large sensor slot; fits most conventional stick-style sensors
- Smaller, adjustable slot for temperature sensors
- Precisely records the number of drops of titrant added during a titration, which is automatically converted into volume
- Includes a cable, Microstirrer (shown below), and reagent reservoir

A Microstirrer is included with the Drop Counter. Additional Microstirrers are available (ORDER CODE MSTIR, $9).

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Acid-base titration
- Standardizing a solution of sodium hydroxide
- Oxidation-reduction titration
- Investigating indicators
- Conductimetric titration and gravimetric determination of a precipitate
- Potentiometric titration of hydrogen peroxide

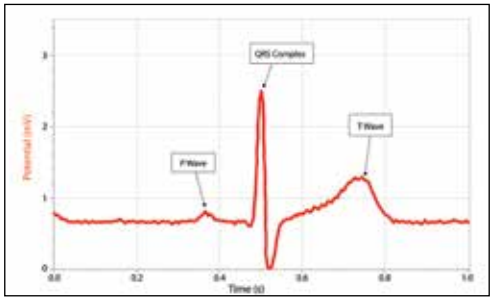
EKG Sensor

$147 ORDER CODE EKG-BTA

Use the EKG Sensor to measure electrical signals produced during muscle contractions.

- Make standard 3-lead EKG tracings to record electrical activity in the heart.
- Collect surface EMG recordings to study contractions in muscles in your arm, leg, or jaw.

Each sensor includes a package of 100 disposable electrodes. Additional packages of 100 electrodes are available (ORDER CODE ELEC, $12).



EKG graph demonstrating the contraction and repolarization of the heart's chambers

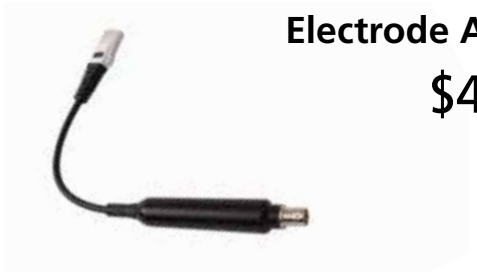
GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Analyzing the heart with EKG
- Introduction to EMG
- Neuromuscular reflexes
- Muscle function analysis
- EMG and muscle fatigue

BIOLOGY
- Monitoring EKG

INNOVATIVE USE
- Monitor the heart rate of crawfish

Electrode Amplifier



$40 ORDER CODE EA-BTA

This sensor is a mV/pH/ORP amplifier that accepts an electrode with a standard BNC connector. It amplifies a –450 mV to +1100 mV signal to a 0 to 5 V range.

It can be used with any of the following:

- Vernier BNC pH Electrode (ORDER CODE PH-BNC, $41)
- Most third-party pH electrodes (with BNC connectors)
- Other high output impedance electrodes
- Most third-party ORP electrodes (with BNC connectors)

See pp. 152–153 for our pH Sensor options.

NEW Go Wireless Electrode Amplifier

$79 ORDER CODE GW-EA

Use the Go Wireless Electrode Amplifier to collect mV or pH data from electrodes with a standard BNC connector. Designed for use with Bluetooth Smart devices such as iPad and LabQuest 2.

BUY WITH CONFIDENCE

Our 5-year warranty on most Vernier products gives you a superior level of buying confidence. In fact, in Vernier's 34 years of business, we have rarely charged a customer for a repair, no matter how old the equipment!

NEW Vernier Energy Sensor

$69 ORDER CODE VES-BTA

The Vernier Energy Sensor offers an easy way to quantify voltage, current, power, and energy output of small wind turbines and solar panels, such as those used in our KidWind Experiment Kits.

The Energy Sensor measures the current and voltage of the system. Data-collection and analysis software, such as Logger *Pro* or LabQuest App, then calculates the power and energy output.

SOURCE INPUT POTENTIAL RANGE: ±30 V

SOURCE INPUT CURRENT RANGE: ±1000 mA

Energy Sensor Accessories

Vernier Variable Load

ORDER CODE **VES-VL, $59**

The Vernier Variable Load is used in conjunction with the Vernier Energy Sensor to provide a range of resistive loads for projects, such as wind turbines or solar panels. Use with the *Renewable Energy with Vernier* lab book.

Vernier Resistor Board

ORDER CODE **VES-RB, $18**

The Vernier Resistor Board provides a small set of load resistors for KidWind wind turbines and solar panels. Use with the *Investigating Wind Energy* lab book.

GREAT WAYS TO USE THIS SENSOR!

ENVIRONMENTAL SCIENCE
- Blade Variables and power output
- Exploring solar panels
- Turbine efficiency

PHYSICS
- Voltage and circuits
- Current and resistors
- Power curves

Ethanol Sensor

$109 ORDER CODE ETH-BTA

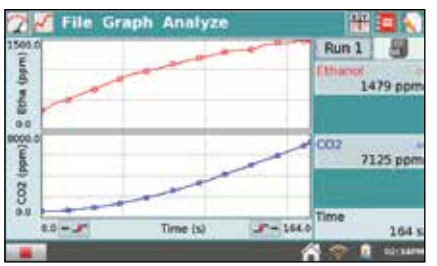
The Ethanol Sensor measures the concentration of ethanol in the air above an aqueous sample.

This sensor has a wide variety of applications.

- Measure the rate of ethanol production by yeast.
- Determine if specific organisms can utilize ethanol fermentation as a metabolic pathway.
- Determine which sugars yeast are able to ferment.
- Investigate variables that increase or decrease the rate of ethanol production.
- Investigate variables that increase or decrease the rate of ethanol production.

RANGE: 0% to 3%

RESOLUTION:
12-bit (LabQuest 2, LabQuest, LabQuest Mini, LabPro, TI-Nspire Lab Cradle): 0.02% from 2-3%, 0.01% from 1-2%, 0.001% from 0-1%
10-bit (CBL 2): 0.04% from 2-3%, 0.02% from 1-2%, 0.002% from 0-1%



Measuring CO_2 gas and ethanol production during fermentation

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Determine which sugars yeast can metabolize
- Observe ethanol and CO_2 production during fermentation

CHEMISTRY
- Measure the concentration of ethanol in a sample

Flow Rate Sensor

$129 ORDER CODE FLO-BTA

Use the Flow Rate Sensor to easily measure stream velocity for environmental or Earth science studies. Flow rate data can be used to calculate the discharge value for the stream or study the sediment transport of the stream.

- Separates into four sections for easy transport and convenient storage.
- Equipped with a 5 m cable, so your data-collection equipment can stay on shore.
- Includes 3 riser rods, which enable the impeller to be placed at fixed depths.

RANGE: 0 to 4 m/s

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.0012 m/s
10-bit (CBL, CBL 2, NXT Adapter): 0.005 m/s

Collecting flow rate data with a LabQuest

GREAT WAYS TO USE THIS SENSOR!

WATER QUALITY
- Measure stream flow rates
- Investigate sediment transport
- Determine stream discharge values

Force Sensors

Dual-Range Force Sensor

$109 ORDER CODE DFS-BTA

Our Dual-Range Force Sensor can be easily mounted on a ring stand or dynamics cart or used as a replacement for a hand-held spring scale. It has two ranges: ±10 N and ±50 N and resolution of 0.01 N and 0.05 N, respectively.

Dual-Range Force Sensor Accessories

Bumper and Launcher Kit, ORDER CODE **BLK, $89**
See page 109 for more information.

Air Track Adapter, ORDER CODE **ATA-DFS, $55**
Allows the Dual-Range Force Sensor to be mounted on the end of an air track for collision studies. Compatible with most air tracks. Includes two magnetic bumpers.

Force Table Adapter, ORDER CODE **FTA-DFS, $29**
Use your Dual-Range Force Sensor with your force table for resolution of vectors experiments. Includes mounting clamp.

Mass For Dynamics Cart, ORDER CODE **MASS, $12**
This 500 g steel block is a great accessory for Newton's second law labs. It attaches to a dynamics cart and leaves room for both a Dual-Range Force Sensor and an Accelerometer.

GREAT WAYS TO USE THESE SENSORS!

PHYSICS
- Newton's second law
- Newton's third law
- Static and kinetic friction
- Impulse and momentum

PHYSICAL SCIENCE
- Frictional forces
- Pulleys

MIDDLE SCHOOL
- Friction
- First-class levers

Force Plate

$245* ORDER CODE FP-BTA

The Force Plate is a large force sensor—tough enough to jump on. About the size and shape of a bathroom scale, the Force Plate has two ranges, one reading up to 3500 N and the other to 800 N. Two handles are included for pushing or pulling. Additional pairs of handles are available (ORDER CODE FP-HAN, $15).

RANGE: -850 to 3500 N and -200 to 850 N

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 1.2 N or 0.3 N
10-bit (CBL, CBL 2, NXT Adapter): 4.8 N or 1.2 N

Studying Newton's third law

*Additional shipping charges may apply due to weight

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Study the dynamics of jumping and walking
- Study how the normal force on your feet changes during an elevator ride
- Try pushing a car across the parking lot
- Use two Force Plates to study Newton's third law

NEW Vernier Structures & Materials Tester

$999* ORDER CODE VSMT

The Vernier Structures & Materials Tester (VSMT) is the perfect device for all project-based STEM and engineering classrooms. Use the VSMT, along with the engineering design method, to design, build, and test structures, conduct bridge competitions, and investigate and analyze beam designs and material properties.

The VSMT is equipped with a load cell and a displacement sensor. Using both sensors allows you to record maximum breaking loads, as well as load/displacement characteristics to allow students to evaluate stress and strain.

The top support beams of the VSMT are designed to easily slide and lock into position. Ruled markings located on the VSMT allow you to accurately position the support beams for center or off-center loading.

The VSMT ships with a well-outfitted VSMT Tackle Kit that includes a 50 x 50 x 6 mm and a 50 x 80 x 6 mm aluminum load plate, chain, rods, U-bolts, and other accessories to make it quick and easy to load bridges, materials, beams and structures of varying sizes and shapes. (Additional VSMT Tackle Kits are available, ORDER CODE VSMT-TK, $49).

LOAD CELL RANGE: 0 to 1000 N

MAXIMUM DISPLACEMENT: 7 cm with a resolution of 0.1 mm

*Additional shipping charges may apply due to weight.

GREAT WAYS TO USE THIS SENSOR!

ENGINEERING & PHYSICS
- Beam design and testing
- Truss design and testing
- Bridge competitions
- Analysis of structures
- Investigating strength of materials
- Determining modulus of elasticity

Gas Pressure Sensor

$83 ORDER CODE GPS-BTA

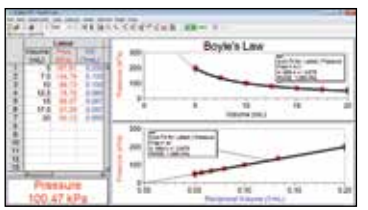
The Gas Pressure Sensor has sufficient resolution and range to work for many subject areas:

Chemistry
- Wide enough range for Boyle's law experiments.
- Sufficient resolution for vapor-pressure or pressure-temperature experiments.

Biology
- Use the included airtight tubing clamps for transpiration experiments.
- Perform respiration experiments in small containers using included fittings.

Includes the Pressure Sensor Accessories Kit (shown above). For replacement parts, see page 163.

RANGE: 0 to 210 kPa (0 to 2.1 atm or 0 to 1600 mmHg)



Studying Boyle's law

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Transpiration
- Enzyme action: testing catalase activity
- Sugar fermentation

PHYSICAL SCIENCE
- Gas pressure and volume
- Gas temperature and pressure

MIDDLE SCHOOL
- Get a grip!
- Fun with pressure

CHEMISTRY
- Boyle's law
- Pressure-temperature
- Volume-temperature relationship in gases
- Vapor pressure of liquids
- Ideal gas law investigation

MATH
- Under pressure: the inverse relationship between pressure and volume

Goniometer

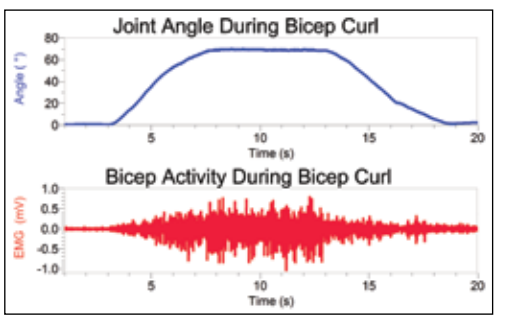
$159 ORDER CODE GNM-BTA

The Goniometer can be used to measure the dynamic motion of a limb during different types of physical activity.

- A set of elastic straps are used to secure the sensor to the subject.
- The lightweight and flexible joint arms allow the limb to move naturally.
- Use it with an EKG Sensor to measure muscle activity during limb motion.
- The sensor can also be detached from the base plate and flexible arms, so it can be used in a variety of STEM and engineering activities.

RANGE: 0 to 340° (±170°)

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.05°
10-bit (CBL, CBL 2, NXT Adapter): 0.12°



Using a Goniometer and EKG Sensor to measure joint angle and muscle activity

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Monitor joint angle
- Determine range of motion
- Muscle function analysis

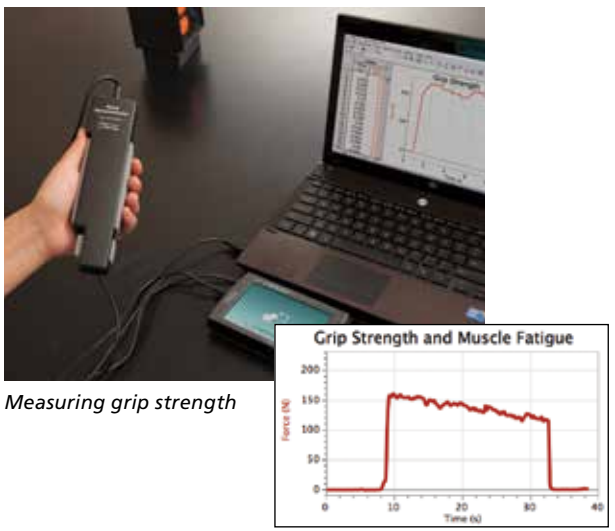
ENGINEERING
- Propeller-powered pendulum

Hand Dynamometer

$99 ORDER CODE HD-BTA

Our strain-gage based isometric dynamometer can be used to measure grip strength or finger-pinch strength. The Hand Dynamometer can be used alone or in combination with EMG recordings for detailed studies of muscular activity.

FORCE RANGE: 0 to 600 N **TYPICAL ACCURACY:** ±0.6 N



Measuring grip strength

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Grip strength comparison
- Grip strength and muscle fatigue
- EMG and muscle strength
- Measure pinch strength in fingers

Heart Rate Sensors

NEW Go Wireless Heart Rate

$89 ORDER CODE GW-HR

The Vernier Go Wireless Heart Rate is ideal for continuously monitoring heart rate before, during, and after exercise or while a person is stationary. Data are wirelessly transmitted to iPad, LabQuest 2, or other mobile devices that are Bluetooth® Smart Ready.

- Simple and easy to use
- Displays heart rate before data collection
- Hand grips do not require electrodes or clips
- Easy to clean and share between students

Hand-Grip Heart Rate Monitor

$119 ORDER CODE HGH-BTA

The Hand-Grip Heart Rate Monitor is ideal for continuously monitoring heart rate before, during, and after exercise or while a person is stationary.

Chest Belt Transmitter

ORDER CODE **CBT, $48**

You can use our Chest Belt Transmitter in conjunction with the Hand-Grip Heart Rate Monitor's receiver for a hands-free option of measuring heart rate.

GREAT WAYS TO USE THESE SENSORS!

HUMAN PHYSIOLOGY
- Heart rate as a vital sign
- Heart rate and exercise
- Heart rate and blood pressure as vital signs
- Effect of coughing on heart rate
- Response to baroreceptor feedback

MIDDLE SCHOOL
- Heart rate and body position
- Heart rate and exercise

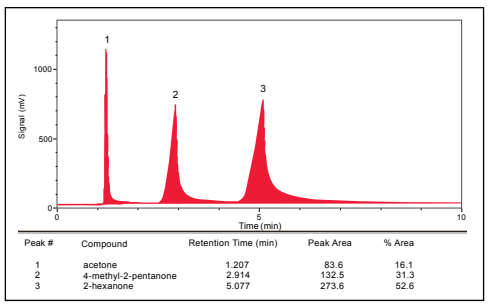
BIOLOGY
- Heart rate and physical fitness
- Ventilation and heart rate

Instrumentation Amplifier

$69 ORDER CODE INA-BTA

The Instrumentation Amplifier is used to amplify small signals so they can be measured with a Vernier interface. The input bandwidth of 10 kHz allows the capture of higher frequency signals. The Instrumentation Amplifier monitors voltages from 20 mV to 1 V full scale (DC or AC). It has six switch settings to allow you to select the best gain. It is often used to amplify the chart recorder or analog output of any instrument, such as a third-party gas chromatograph. You can also use the Instrumentation Amplifier to measure small induced currents in coils.

RANGE SETTINGS: 0–20 mV, 0–200 mV, 0–1 V, ±20 mV, ±200 mV, ±1 V



Data collected using an Instrumentation Amplifier attached to a third-party gas chromatograph

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Investigating resistivity
- Use to amplify signals from third-party laboratory instruments
- Use to replace a strip-chart recorder for recording instrument data

Ion-Selective Electrodes

$179 ORDER CODE **SEE BELOW**

Our Ion-Selective Electrodes (ISEs) are for monitoring five environmentally important ions: Nitrate (NO_3^-), Chloride (Cl^-), Calcium (Ca^{2+}), Ammonium (NH_4^+), and Potassium (K^+).

- The Nitrate, Calcium, Potassium, and Ammonium ISEs are combination-style, non-refillable, and gel-filled. The Chloride ISE is a solid state device; it does not have a replacement module.
- Vernier ISE membranes, like all other PVC ISE membranes, have a limited life expectancy. However, the replaceable module of Vernier ISEs allows you to simply discard the used membrane module, and replace it with a new one. To purchase replacement modules, see page 163.
- Included with each ISE are two calibration standards and a short-term soaking bottle. To purchase additional standards, see page 163.

AMMONIUM ISE:
RANGE: 1 to 18,000 mg/L or ppm

NITRATE ISE:
RANGE: 1 to 10,000 mg/L or ppm

CALCIUM ISE:
RANGE: 1 to 40,000 mg/L or ppm

POTASSIUM ISE:
RANGE: 90 to 39,000 mg/L or ppm

CHLORIDE ISE:
RANGE: 10 to 20,000 mg/L or ppm

Ammonium ISE
ORDER CODE **NH4-BTA, $179**

Nitrate ISE
ORDER CODE **NO3-BTA, $179**

Calcium ISE
ORDER CODE **CA-BTA, $179**

Potassium ISE
ORDER CODE **K-BTA, $179**

Chloride ISE
ORDER CODE **CL-BTA, $179**

Ion-Selective Electrodes require good chemical technique and careful calibration to obtain accurate results. They are not recommended for middle school or elementary school students. ISE modules are covered by a one-year warranty.

GREAT WAYS TO USE THESE SENSORS!

WATER QUALITY
- Calcium and water hardness
- Chloride and salinity
- Monitor ammonium concentration
- Monitor nitrate concentration

Light Sensor

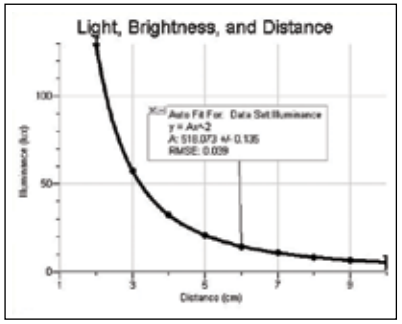
$55 ORDER CODE **LS-BTA**

Our Light Sensor approximates the human eye in spectral response and can be used over three different illumination ranges that you select with a switch. Use it for inverse-square law experiments or for studying polarizers, reflectivity, or solar energy.

LOW RANGE:
0 to 600 lux

MEDIUM RANGE:
0 to 6000 lux

HIGH RANGE:
0 to 150,000 lux



Inverse square law of light

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Polarization of light
- Inverse square law

PHYSICAL SCIENCE
- Reflectivity of light
- Polaroid filters
- How bright is the light?

MATH
- Inverse square relationship
- Periodic phenomena

MIDDLE SCHOOL
- Reflectivity of light
- Schoolyard study

EARTH SCIENCE
- Reflection and absorption of light
- Photovoltaic cells
- Measuring particulates

Magnetic Field Sensor

$58 ORDER CODE **MG-BTA**

Use the Magnetic Field Sensor to study the field around permanent magnets, coils, and electrical devices.

- Sensitive enough to measure the Earth's magnetic field.
- Rotating tip allows you to measure both transverse and longitudinal magnetic fields.

LOW SENSITIVITY:
RANGE: -6.4 to +6.4 millitesla (mT)

HIGH SENSITIVITY:
RANGE: -0.32 to +0.32 mT

Mapping a magnetic field

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- The magnetic field in a coil
- The magnetic field in a slinky
- The magnetic field of a permanent magnet

PHYSICAL SCIENCE
- Electromagnets

MIDDLE SCHOOL
- Mapping a magnetic field

EARTH SCIENCE
- Exploring magnetism
- Where is north?
- Searching for iron ore

Melt Station

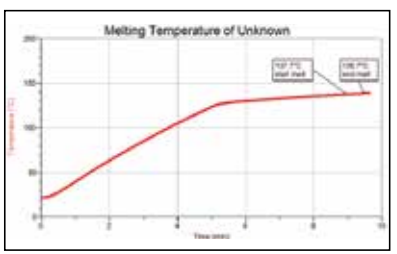
$469* ORDER CODE MLT-BTA

Our Melt Station is used to measure the melting temperature of solid substances.

- Accurate results using built-in RTD over a range of 20°C to 260°C
- High-quality 6X viewing lens for clear observation of the samples
- Innovative, adjustable tilt allows for optimal viewing angle
- Cooling fan reduces time between tests

Each Melt Station comes with 100 standard capillary tubes. Additional packages of 100 are available, (ORDER CODE MLT-TUBE, $15).

RANGE: 20°C to 260°C
ACCURACY: ± 0.2°C up to 200°C, ± 0.4°C above 200°C
CALIBRATION: factory calibrated
POWER: separate AC power supply (included)
DIMENSIONS: 9 cm × 11 cm × 26 cm
FOOTPRINT: 13 cm × 15 cm



Sample graph of temperature vs. *time marking the melting temperature*

*Additional shipping charges may apply due to weight.

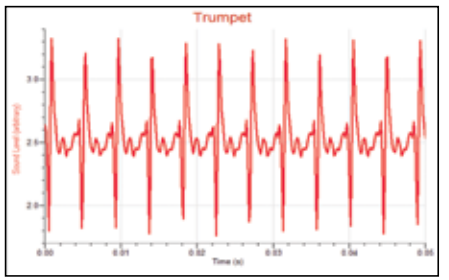
GREAT WAYS TO USE THIS SENSOR!

ORGANIC CHEMISTRY
- Determining melting temperature
- Recrystallization of benzoic acid and aspirin
- Identifying unknown analgesic
- Separation of organic compounds
- Synthesis of dibenzalacetone by aldol condensation

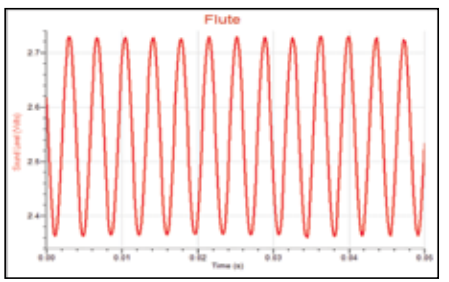
Microphone

$39 ORDER CODE MCA-BTA

Use our Microphone to display and study the waveforms of sounds from voices and musical instruments. It is also appropriate for speed of sound experiments.



Waveform of a trumpet



Waveform of a flute

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Sound waves and beats
- Tones, vowels and telephones
- Investigate musical scales
- Speed of sound

MATH
- Sound waveform modeling

FORENSICS
- Identify the musical notes that make up the combination to a safe

Mini GC Plus

$1,989 ORDER CODE GC2-MINI

Use the Vernier Mini GC Plus gas chromatograph to separate and identify ketones, alcohols, esters, halogenated alkanes, and substituted aromatics. Perform analysis and peak integration using LabQuest as a standalone device or with Logger *Pro* software on a computer. The Mini GC Plus is covered by a two-year warranty (syringe, column, sensor, and septa excluded). More details on page 61.

FAMILIES OF COMPOUNDS THAT CAN BE USED IN THE MINI GC PLUS:
Alcohols, aldehydes, substituted aromatic hydrocarbons, carboxylic acids, chlorinated hydrocarbons, esters, ethers, ketones, nitriles, and more.

MEMS DETECTOR:
The unique Seacoast Science MEMS Chemi-Capacitive Detector is state-of-the-art technology that allows air to be used as the carrier gas.

COLUMN:
High-quality Restek MXT-1 stainless steel capillary column (11 meter)

TEMPERATURE REGULATION:
Software-controlled temperature regulation from 30–160°C

COLUMN TEMPERATURE RAMP:
- Maximum of 10°C/minute
- Short warm-up time: <10 minute max for most labs

PRESSURE REGULATION:
Software-controlled pressure regulation from 1–21 kPa above ambient

INJECTION:
- Comes with one high-quality 1 µL Hamilton syringe
- Injection is direct from syringe to column
- Liquid injection volume: 0.01 to 0.50 µL

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Using a gas chromatograph: identifying unknown compounds
- Verification of esterification
- Quantifying substances in a mixture
- Fractional distillation
- Investigating gas chromatography

ORGANIC CHEMISTRY
- Fractional distillation of esters
- Enthalpy of vaporization

Vernier Motion Encoder System

The Motion Encoder System is a revolutionary way for physics students to study dynamics. Optical position measurement means the end to setup frustration, keeping the focus on the physics.

Vernier Motion Encoder System

ORDER CODE **VDS-EC, $424***

Includes 1.2 m Vernier Dynamics Track/Optics Bench with Motion Encoder Track Strip, one Motion Encoder Cart and Receiver, one Plunger Cart, 500 g Mass, Adjustable End Stop, two Adjustable Two Foot Levelers, and brackets for attaching Photogates and a Motion Detector, if desired. Carts include magnetic and hook-and-pile end caps.

Motion Encoder Upgrade Kit

ORDER CODE **MEU-VDS, $145**

Includes Motion Encoder Cart parts, Receiver, and Motion Encoder Track Strip. Purchase this kit to upgrade your existing Vernier Dynamics System to a Motion Encoder System. One-time assembly required to modify your Cart.

Motion Encoder Cart and Receiver

ORDER CODE **MEC-VDS, $229**

Includes complete Motion Encoder Cart, Receiver, and Motion Encoder Track Strip. Add the Motion Encoder Cart and Receiver to an existing Vernier Dynamics System to upgrade it to a Motion Encoder System. No assembly required.

For more details, see pp. 110–112.

*Additional shipping charges may apply due to weight.

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Cart on a ramp
- Newton's second law
- Conservation of momentum
- Momentum-impulse theorem
- Friction
- Back and forth motion

Motion Detectors

Motion Detector

$79 ORDER CODE **MD-BTD**

The Motion Detector uses ultrasound to measure the position of carts, balls, people, and other objects.
- Measure objects as close as 15 cm and as far away as 6 m.
- Sensitivity switch reduces noise and produces higher quality data for studying dynamics carts on tracks.
- Attaches easily to the Vernier Dynamics System.
- Pivoting head allows for flexibility in the experimental setup.
- Can be used with LabQuest, LabQuest 2, LabQuest Mini, LabPro, and CBL 2. Not supported with Go!Link or EasyLink.

RANGE:	RESOLUTION:	SENSITIVITY:
0.15 to +6 meters	1 mm	2 settings

Go! Motion

$109 ORDER CODE **GO-MOT**

The Go!Motion has the same features as our Motion Detector but connects directly to your computer or LabQuest by USB—no other equipment is needed. Compatible with Mac OS X and Windows.

RANGE:	RESOLUTION:	SENSITIVITY:
0.15 to +6 meters	1 mm	2 settings

Motion Detector Clamp

ORDER CODE **MD-CLAMP, $7**

The Motion Detector Clamp attaches to the back of the Motion Detector or Go! Motion. The clamp can be attached to a variety of objects, such as table tops and ring stands.

O_2 Gas Sensor

$188 ORDER CODE **O2-BTA**

The O_2 Gas Sensor measures oxygen concentration in air. The wide measurement range allows it to be used to study human and cellular respiration.
- Perform or complement many experiments conducted using the CO_2 Gas Sensor.
- Includes a 250 mL bottle that can be used to study the rusting of iron or as a respiration chamber for monitoring plants and insects.

The electrochemical cell in the O_2 Gas Sensor is covered by a 5-year warranty, but has a life expectancy of 6 to 8 years. This cell can only be replaced in units of the style pictured above. Contact Vernier for information and pricing.

RANGE: 0 to 27% (0 to 270 ppt)
Normal operating temp range: 25°C (±5°C)
Operating temp range: 5–40°C (with calibration)
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.01%
10-bit (CBL, CBL 2, NXT Adapter): 0.04%

BioChambers

BioChambers provide a way for both CO_2 Gas and O_2 Gas sensors to be used at the same time in a closed system.

BioChamber 2000, 2000 mL
ORDER CODE **BC-2000, $19**

BioChamber 250, 250 mL
ORDER CODE **BC-250, $6**

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Enzyme action: testing catalase activity
- Cell respiration in peas
- Effect of temperature on cold-blooded organisms
- Oxygen gas and human respiration
- Photosynthesis and respiration
- Measure O_2 along with CO_2 in photosynthesis and respiration

HUMAN PHYSIOLOGY
- Oxygen and aerobic metabolism
- Oxygen and extraction by the lungs
- Effect of "dead space" on oxygen availability

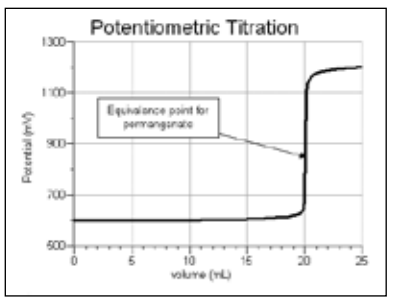
ORP Sensor

$79 ORDER CODE ORP-BTA

The Oxidation-Reduction Potential (ORP) Sensor lets you measure the ability of a solution to act as an oxidizing or reducing agent.

- Measure the oxidizing ability of chlorine in swimming pools or determine when the equivalence point has been reached in an oxidation-reduction reaction.
- Amplifier included.

REDOX POTENTIAL RANGE: -450 to +1100 mV
TEMPERATURE RANGE: 0 to 60°C (not compensated)



ORP mV vs. volume data for the titration of hydrogen peroxide solution with potassium permanganate

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- An oxidation-reduction titration: the reaction of Fe^{2+} and Ce^{4+}
- Potentiometric titration of hydrogen peroxide and permanganate
- Measure oxidizing potential of chlorine in swimming pools

PAR Sensor

$189 ORDER CODE PAR-BTA

The PAR (Photosynthetically Active Radiation) Sensor measures photosynthetic light levels in both air and water. It features a waterproof sensor head and can be used to measure Photosynthetic Photon Flux Density (PPFD) from sunlight and electric light sources. It is sensitive to visible light in the spectral range that is used by plants in photosynthesis (400–700 nm). This sensor is ideal for experiments investigating photosynthesis and primary productivity and can also be used in many agricultural and environmental science applications.

PAR RANGE: 0 to 2000 µmol m^{-2} s^{-1} in full sun
ABSOLUTE ACCURACY: ±5%
REPEATABILITY: ±1%
LONG-TERM DRIFT: Less than 3% per year
COSINE RESPONSE: 45° zenith angle: 1%
75° zenith angle: ±5%
WAVELENGTH RANGE: 410 nm to 655 nm
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, Go!Link, LabPro): 1 µmol m^{-2} s^{-1}

Measuring photosynthetically active radiation (PAR) in a park

GREAT WAYS TO USE THIS SENSOR!

ENVIRONMENTAL SCIENCE
- Monitor the photosynthetic energy from the sun
- Compare the photosynthetic energy of artificial light sources
- Monitor the photosynthetic energy from the sun in different environments
- Compare photosynthetic energy at different depths

pH Sensors

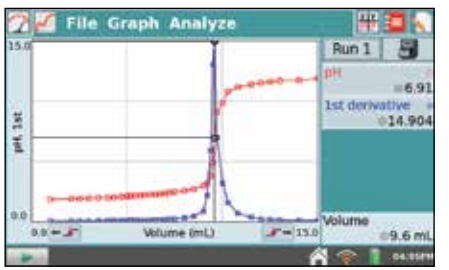
NEW Go Wireless® pH

$99 ORDER CODE GW-PH

Go Wireless pH is a versatile pH sensor perfect for anyone wanting to do wireless pH measurements using supported Bluetooth® Smart Ready devices, such as LabQuest 2 (model LQ2-LE) or iPad (third generation or newer). With Go Wireless pH, students can investigate

- pH of house acids and bases
- Acid-base titrations
- pH and alkalinity for water quality

RANGE: pH 0–14
ACCURACY: ±0.5 pH units (factory calibration)
±0.1 pH units (user calibration)
RESPONSE TIME: 2 s (to 90% of full reading in buffer)



Acid-base titration with the Go Wireless pH

NEW Go Wireless pH Electrode

ORDER CODE **GW-PH-BNC, $40**

This is a replacement pH electrode for Go Wireless pH.

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Conduct acid-base titrations

WATER QUALITY
- Measure pH and alkalinity

PHYSICAL SCIENCE
- Investigate household acids and bases

pH Sensor

$79 ORDER CODE PH-BTA

Our general purpose pH Sensor is an Ag-AgCl combination electrode. It can be used across disciplines, including chemistry, biology, middle school science, and environmental science.

- Includes a convenient soaking bottle and storage solution.
- pH Buffer Capsules (ORDER CODE PHB, $12) and pH Storage Solution (ORDER CODE PH-SS, $16) are available.

TYPE: Sealed, gel-filled, epoxy body, Ag/AgCl
RANGE: pH 0–14
TEMPERATURE RANGE: 5 to 80°C (not compensated)

Tris-Compatible Flat pH Sensor

$99 ORDER CODE FPH-BTA

This specialty pH Sensor uses a double-junction electrode, making it compatible with Tris buffers and solutions containing proteins. The flat glass shape also makes it ideal for measuring the pH of semisolids such as soft food or soil.

GREAT WAYS TO USE THESE SENSORS!

pH SENSOR

CHEMISTRY
- Acid-base titration
- Titration of a diprotic acid: identifying an unknown
- Acid dissociation constant, K_a
- Investigating indicators
- Investigating buffers

PHYSICAL SCIENCE
- Household acids and bases
- Acid rain

BIOLOGY
- Interdependence of plants and animals
- Watershed testing

TRIS-COMPATIBLE FLAT pH SENSOR

AGRICULTURAL SCIENCE
- Soil pH

BIOLOGY
- Applications involving Tris buffers or proteinaceous solutions

EARTH SCIENCE
- Soil pH
- Soil and acid rate

Photogate and Accessories

Photogate

$45 ORDER CODE VPG-BTD

Use the Vernier Photogate to study free fall, rolling objects, collisions, and pendulums.

- Use the built-in laser detector to create a photogate through which you could drive a truck.
- Connect up to four gates in a chain.
- Includes an accessory rod for attachment to a ring stand or for adding the Ultra Pulley Attachment.

Photogate Accessories

Ultra Pulley Attachment

ORDER CODE SPA, $24

Add an Ultra Pulley to your Photogate to monitor motion as a string passes over the pulley or as the pulley rolls along a table.

Picket Fence

ORDER CODE PF, $7

Our Picket Fence has 8 opaque bars silk-screened at intervals of 5 cm directly onto clear plastic. These devices are especially good for dropping through a photogate to study free fall.

Cart Picket Fence

ORDER CODE PF-CART, $6

Attaches to Vernier Dynamics Carts.

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Determining the acceleration due to gravity
- Determining the speed of a rolling object
- Measure acceleration in an Atwood's machine
- Measure pendulum periods

Laser Pointer

ORDER CODE LASER, $19

This Class 2 (<1 mW) laser pointer can be used with the Vernier Photogate to produce a gate that is wider than the normal 7.5 cm spacing, making it possible to measure the speed of an automobile or of a person running. The laser case is made of aircraft aluminum and uses two AAA batteries (included). The wavelength of the light is 650 nm.

Laser Pointer Stand

ORDER CODE STAND, $14

This light-weight tripod is a perfect support for the laser described above, which has a 1.1 cm outside diameter. The stand features fold-out legs and a clip attached to the adjustable ball. A socket head assembly securely holds the laser in place. This assembly allows you to accurately point the laser at the photogate. A hook-and-pile strap, integrated into one of the tripod legs, allows you to attach the laser to objects, such as ring stands and railings.

Pulley Bracket

ORDER CODE B-SPA, $12

The Pulley Bracket attaches an Ultra Pulley to the end of a Vernier Dynamics Track.

Photogate Bar Tape Kit

ORDER CODE TAPE-VPG, $17

The Photogate Bar Tape Kit contains a flexible plastic tape called "Bar Tape" and a guide that allows the tape to be used with a Vernier Photogate. The tape can be attached to objects and pulled through the photogate. This allows you to perform experiments much like what you would do with a ticker tape timer.

Polarimeter (Chemical)

$499* ORDER CODE CHEM-POL

The Chemical Polarimeter is an instrument used for measuring the rotation of plane-polarized light caused by an optically active substance. The Polarimeter is a vertical polarimeter that uses a yellow LED at 589 nm, a fixed polarizer, and a rotating polarizer (also called an analyzer) to detect changes in rotation of plane-polarized light in the presence of an optically active compound. One sample cell is included.

RANGE: ±180°
RESOLUTION*: 0.25°
LIGHT SOURCE: LED
WAVELENGTH: 589 nm
*This is the resolution of the analyzer. Typical absolute optical rotation measurements have a repeatability of ±1°.

Polarimeter Sample Cells

ORDER CODE **CELLS-POL, $66**

Package of four replacement sample cells for the Chemical Polarimeter.

Product Specifications:

- Flat-bottom glass tube
- 20 mm inner diameter x 150 mm tall
- Screen-printed ruler with centimeter markings
- Pour spout

*Additional shipping charges may apply due to weight.

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY/CHEMISTRY

- Determine sugar solution purity by optical rotation
- Characterize purity of inorganic syntheses yielding chiral products
- Study the kinetics of acid-catalyzed hydrolysis
- Study kinetics of enzyme-catalyzed hydrolysis
- Explore the optical activity of amino acids

ORGANIC CHEMISTRY

- Investigate reactions of natural products by optical rotation
- Characterize purity of organic syntheses yielding chiral products
- Determine enantiometric purity of optically active compounds

Power Amplifier

$199 ORDER CODE PAMP

Drive loads with ±10 V and currents up to 1 A with the Vernier Power Amplifier. The Power Amplifier can drive a variety of loads, including speakers, lamps, motors, and circuits, using sine, square, and other waveforms.

- Utilizes internal feedback for accurate AC waveforms and DC levels.
- Provides a steady, linearly controlled DC output for driving loads like DC motors and precise AC waveforms for driving things like speakers.
- Current limited to protect against overload and shorting.
- Current monitor function logs current.
- Class A-B push-pull amplifier provides low distortion with good efficiency.
- Works with LabQuest, LabPro, and SensorDAQ

OUTPUT VOLTAGE SWING (AMPLITUDE): ±10 V
MAX. OUTPUT CURRENT: 1 A
FREQUENCY RESPONSE: DC-20 kHz (-3 db @ 20 kHz, flat to ~15 kHz)
OUTPUT IMPEDANCE: <1 Ω

Power Amplifier Accessory Speaker

ORDER CODE **PAAS-PAMP, $99**

This kit includes a speaker and accessories used with the Vernier Power Amplifier to study mechanical waves. The speaker contains a lightweight metal disc glued to the speaker cone.

GREAT WAYS TO USE THIS SENSOR!

PHYSICS

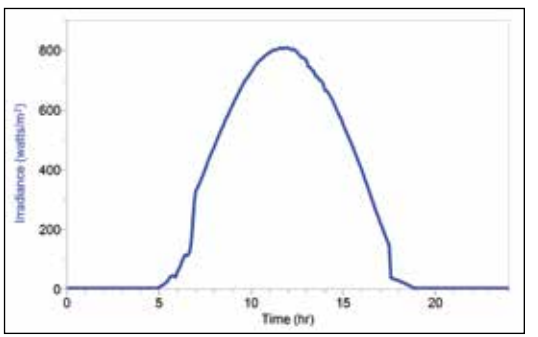
- Produce standing wave patterns by vibrating one end of a string
- Investigate longitudinal resonance by oscillating a spring with a mass attached
- Study how resistance changes with heat by supplying a low frequency waveform to a incandescent lamp
- Study RC and RLC circuits

Pyranometer

$199 ORDER CODE PYR-BTA

The Vernier Pyranometer measures the power of electromagnetic radiation in watts per square meter. It is sensitive to the near infrared, visible, and UV ranges, where nearly all of the solar energy is concentrated. It is great for experiments with solar cells and calculating their efficiency. The sensor is weatherproof and has a dome-shaped top to allow it to work with a wide range of sun angles. The Pyranometer has a 6 m cable.

IRRADIANCE RANGE: 0 to 1100 W/m²
ABSOLUTE ACCURACY: ±5%
COSINE RESPONSE: 45°±1%
75°±5%



Pyranometer readings on a sunny day

GREAT WAYS TO USE THIS SENSOR!

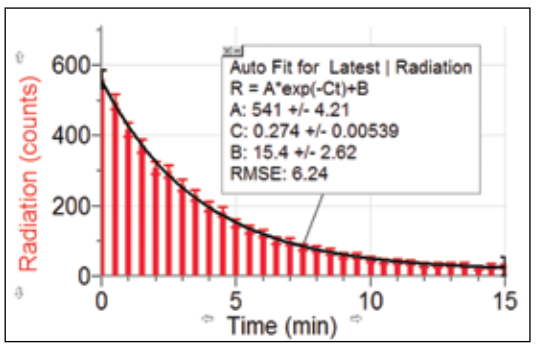
ENVIRONMENTAL SCIENCE

- Monitor the energy from the sun
- Determine the efficiency of a solar panel
- As a control in solar panel studies

Vernier Radiation Monitor

$169 ORDER CODE **VRM-BTD**

The Vernier Radiation Monitor consists of a Geiger-Mueller tube mounted in a small, rugged, plastic case. It requires no battery, getting power from the data-collection interface. A thin window protected by a metal screen allows alpha radiation to be detected, along with beta and gamma. It can be used to explore radiation statistics, measure the rate of nuclear decay, and monitor radon progeny.



Radioactive decay

GREAT WAYS TO USE THIS SENSORS!

PHYSICS

NUCLEAR RADIATION
- Distance and radiation
- Lifetime measurement
- Counting statistics
- Background radiation sources

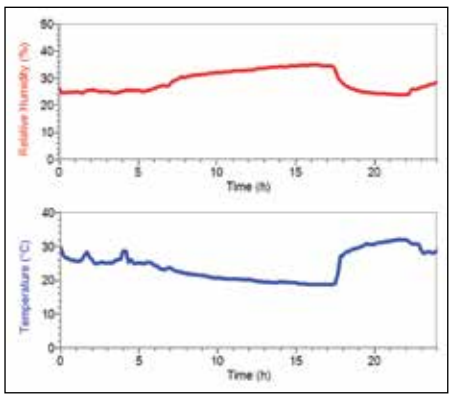
CHEMISTRY
- Alpha, beta, and gamma
- Radiation shielding
- Determining the half-life of an isotope

Relative Humidity Sensor

$69 ORDER CODE **RH-BTA**

The Relative Humidity Sensor contains an integrated circuit that can be used to monitor relative humidity over the range of 0 to 95% (±5%). Use this sensor for weather studies, monitoring greenhouses, or for determining days when static electrical discharges could be a problem.

RANGE: 0 to 95%
RESOLUTION: 0.04%
OPERATING TEMPERATURE RANGE: 0 to 85°C



Indoor relative humidity and temperature for a 24-hour period at Vernier

GREAT WAYS TO USE THIS SENSOR!

EARTH SCIENCE
- Air temperature and relative humidity

ENVIRONMENTAL SCIENCE
- A local weather study
- Ecocolumn investigations

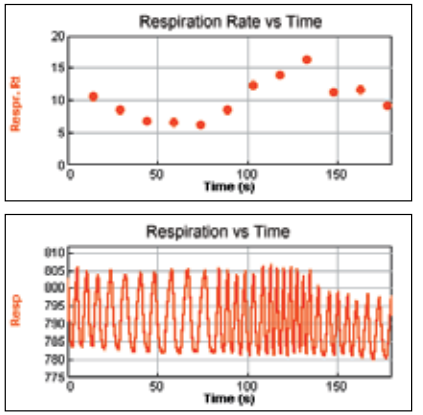
INNOVATIVE USES
- Relative humidity in caves
- Monitoring indoor relative humidity for health

Respiration Monitor Belt

$63 ORDER CODE **RMB**

(Requires GPS-BTA)

Use the Respiration Monitor Belt with our Gas Pressure Sensor (see below) to measure human respiration. Simply strap the belt around your chest and pump air into the belt with the hand bulb. Monitor the pressure associated with the expansion and contraction of your chest during breathing.



Monitoring respiration rate

Gas Pressure Sensor

ORDER CODE **GPS-BTA, $83**

This sensor is required for use with the Respiration Monitor Belt above. Details on page 147.

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Studying human respiration

BIOLOGY
- Control of human respiration

Rotary Motion Sensor

$169 ORDER CODE RMV-BTD

Monitor angular motion precisely and easily with the Rotary Motion Sensor.

- Collect angular displacement, angular velocity, and angular acceleration data
- Direction sensitive
- Measure linear position to a fraction of a millimeter

STANDARD RESOLUTION: 1.0° (angular velocity up to 30 rev/s)

HIGH RESOLUTION: 0.25° (angular velocity up to 7.5 rev/s)

Rotational Motion Accessory Kit

ORDER CODE **AK-RMV, $110**

This accessory kit is used to study the motion of a physical pendulum; the rotational inertia of disks, rings, and point masses; and the conservation angular momentum. The kit includes

- Two 8.9 cm diameter, 0.6 cm thick solid aluminum disks
- One steel disk with 2.9 cm central hole
- One plastic hub to hold the steel disk on the 3-step pulley
- One 38 cm hollow aluminum rod
- One Ultra Pulley
- One Ultra Pulley Swivel Mount, which allows the pulley to be mounted on the Rotary Motion Sensor

For more details, visit **www.vernier.com/ak-rmv**

Rotary Motion Motor Kit

ORDER CODE **MK-RMV, $12**

This kit includes a small electric motor with pulley, rubber band belt, motor clip, and mounting screw. The motor can be attached to the Rotary Motion Sensor, and it can be used as an analog tachometer or generator. You can also perform experiments that investigate motor efficiency in different conditions. For more details, visit **www.vernier.com/mk-rmv**

GREAT WAYS TO USE THIS SENSOR!

PHYSICS

- Atwood's machine experiments
- Measuring moments of inertia
- Torque experiments
- Physical pendulum
- Conservation of angular momentum

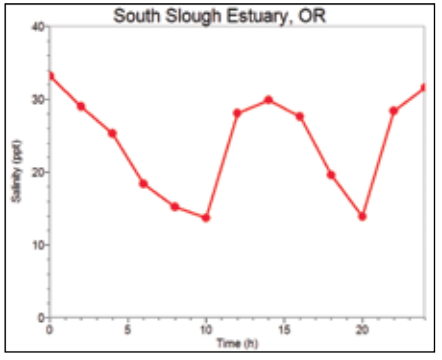
Salinity Sensor

$99 ORDER CODE SAL-BTA

The Salinity Sensor measures the total dissolved salt content in ocean or brackish water.

- Measure water with a wide variety of salinities, from brackish water to ocean water, and even hyper-saline environments.
- Study how salinity affects buoyancy, or monitor salinity values in estuaries where fresh water mixes with salty ocean water.

RANGE: 0 to 50 ppt



Measuring salinity in an estuary

GREAT WAYS TO USE THIS SENSOR!

ENVIRONMENTAL SCIENCE

- Studying salinity in an estuary
- Measure salinity in ocean or brackish water

INNOVATIVE USES

- GIS mapping enhances salinity
- Investigating salinity levels
- Ionic and molecular compounds
- Find the relationship between conductivity and concentration

Soil Moisture Sensor

$95 ORDER CODE SMS-BTA

The Soil Moisture Sensor uses capacitance to measure the water content of soil. Simply insert this rugged sensor into the soil to be tested, and the volumetric water content of soil is reported in percent. Use it to conduct experiments in ecology, environmental science, agricultural science, horticulture, biology, and more.

RANGE: 0 to 45% volumetric water content

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.1%
10-bit (CBL, CBL 2, NXT Adapter): 0.4%

Monitoring changes in soil moisture in ecocolumns

GREAT WAYS TO USE THIS SENSOR!

EARTH SCIENCE

- Measure the loss of soil moisture over time due to evaporation and plant uptake
- Evaluate optimum soil moisture contents for various species of plants
- Monitor soil moisture content to control irrigation in greenhouses

ENVIRONMENTAL SCIENCE

- Manage garden soil moisture
- Ecocolumn investigations
- Pollution study

AGRICULTURAL SCIENCE

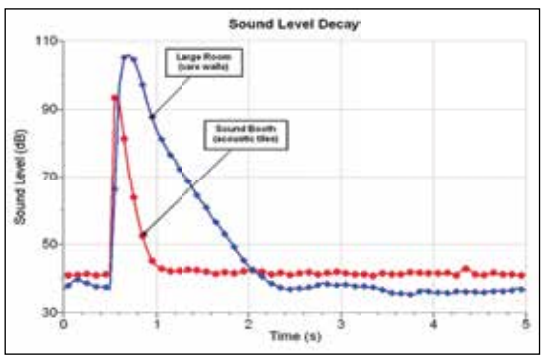
- Soil moisture

Sound Level Meter

$165 ORDER CODE SLM-BTA

Measure sound level in decibels (dB) with our Sound Level Meter. An output port on the meter records sound level data. A switch on the meter is used to select dBA or dBC weighting. The Sound Level Meter also has an LCD panel, which allows you to use it as a standalone device. A dB range switch and a response switch provide flexibility in standalone mode.

RANGE: 35 to 130 dB
ACCURACY: 1.5 dB at 94 dB
FREQUENCY RESPONSE: 31.5 to 8,000 Hz



Sound level decay in two rooms

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Study reverberation times
- Investigating airport noise
- Investigate room acoustics
- Measuring sound levels at a pep rally
- Investigate traffic noise
- Use for environmental noise studies

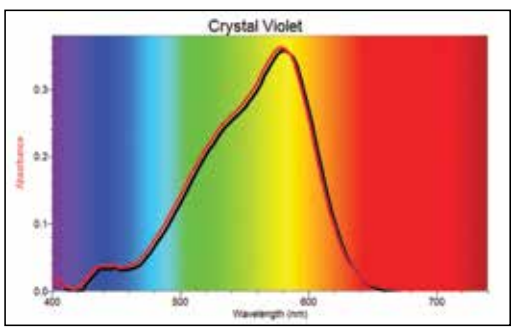
Spectrometers

SpectroVis® Plus Spectrophotometer

$469 ORDER CODE SVIS-PL

SpectroVis Plus is an affordable, portable, visible to near-IR spectrophotometer and fluorometer. Details on page 63.

RANGE: 380 to 900 nm
Fluorescence excitation centered at 405 nm and 500 nm
SPECIFICATIONS:
±3.0 nm wavelength accuracy at 650 nm, 1 nm reporting intervals



Absorbance spectrum of crystal violet

For more on spectrometers, see pp. 62–63.

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Beer's law
- Kinetics studies
- Determine chemical composition based on absorption spectra

ORGANIC CHEMISTRY
- Grignard formation of crystal violet
- Synthesis of fluorescein
- Synthesis of methyl orange and its application to textiles

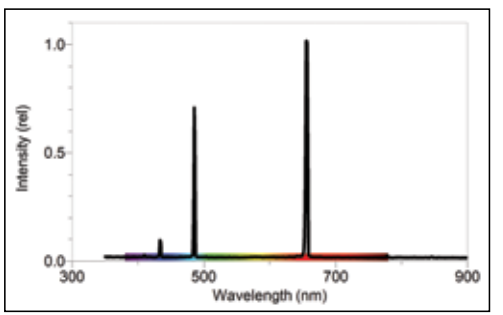
BIOLOGY
- Visible spectrum of chlorophyll
- Photosynthesis

Vernier Emissions Spectrometer

$799 ORDER CODE VSP-EM

This is the perfect tool to conduct emissions analysis. The Vernier Emissions Spectrometer allows you to instantly collect emissions spectra from light bulbs, gas discharge tubes, or the sun. It connects directly to your computer or LabQuest with a standard USB cable and gives precise measurements over a range of 350–900 nm. Use the Vernier Emissions Spectrometer with or without an optical fiber.

RANGE: 350 to 900 nm
SPECIFICATIONS:
±1.0 nm wavelength accuracy, 1 nm reporting intervals



Hydrogen discharge tube emission spectrum

Vernier Emissions Fiber

ORDER CODE VSP-EM-FIBER, $88

This 400 µm diameter optical fiber is used to pipe light from sources to the Vernier Emissions Spectrometer.

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Emission spectra of gases
- Emission spectra of lamps
- Reflectance spectra

CHEMISTRY
- Calculate the Rydberg constant
- View gas discharge spectral lines

Spectrometers (continued)

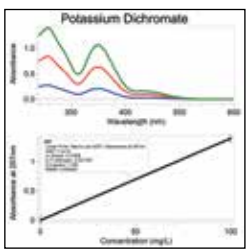
Vernier UV-VIS Spectrophotometer

$1,999 ORDER CODE VSP-UV

The Vernier UV-VIS Spectrophotometer is a portable ultraviolet and visible light spectrophotometer appropriate for advanced high school, college, or graduate level education. It is an easy and accurate instrument ideal for measuring the absorbance spectra of various chemical and biochemical compounds. As a USB device, it plugs directly into your computer or LabQuest.

POWER SUPPLY: AC adapter (included)
LIGHT SOURCE: deuterium (UV) and incandescent (VIS)
DETECTOR: Linear CCD
WAVELENGTH RANGE: 220 to 850 nm
WAVELENGTH REPORTING INTERVAL: ~1 nm
WAVELENGTH ACCURACY*: ±2.0 nm

*as determined with holmium oxide NIST standard



Absorbance spectrum of potassium dichromate

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Beer's law
- Kinetics studies
- Determine chemical composition based on absorption spectra

ORGANIC CHEMISTRY
- Grignard formation of crystal violet
- Synthesis of fluorescein
- Synthesis of methyl orange and its application to textiles

BIOLOGY
- Visible spectrum of chlorophyll
- Photosynthesis

Spirometer and Replacement Parts

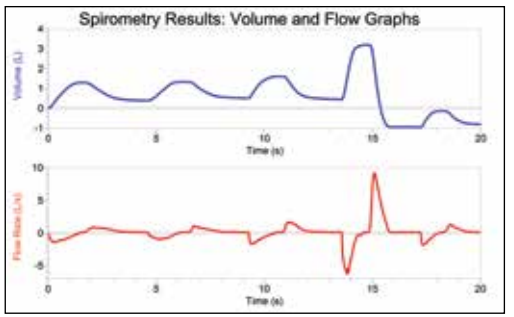
Spirometer

$199 ORDER CODE SPR-BTA

Use the Spirometer to perform a variety of tests related to air flow and lung volume.

- Designed to measure human respiration at rest and during moderate activity.
- Includes a removable flow head (22 mm ID/30 mm OD) for easy cleaning and sterilization, in addition to 5 disposable mouthpieces, 1 disposable bacterial filter, and 2 nose clips.

FLOW RANGE: ±600 L/min **DEAD SPACE:** 93 mL



Measuring lung volume

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Lung volumes and capacities
- Respiratory response to physiologic challenges
- Analysis of lung function
- Oxygen and aerobic metabolism

Disposable Bacterial Filter
(pkg. of 10)
ORDER CODE **SPR-FIL, $30**

Use of the disposable microbacterial filter significantly reduces how often you will need to sterilize your spirometer's flow head. The filter's 30 mm ID opening allows for an easy, air-tight fit to the flow head.

Disposable Mouthpiece
(pkg. of 30)
ORDER CODE **SPR-MP, $10**

For a more sterile environment, use the cardboard mouthpieces to help eliminate the spreading of contagious material between students.

Noseclip *(pkg. of 10)*
ORDER CODE **SPR-NOSE, $10**

These plastic, foam-padded noseclips help increase the precision of your spirometry results by eliminating the escape of air through the nostrils during testing.

Extra Spirometer Flow Head
ORDER CODE **SPR-FLOW, $60**

An extra flow head eliminates equipment downtime while sterilizing your original flow head. The flow head consists of a polycarbonate outer body with a stainless steel inner mesh.

O_2 Gas Sensor to Spirometer Adapter
ORDER CODE **O2-SPR, $8**

This adapter facilitates the connection between an Oxygen Gas Sensor and a Spirometer when measuring the oxygen gas concentration and flow rate of exhaled air.

Temperature Probes

Stainless Steel Temperature Probe

$29 ORDER CODE TMP-BTA

This rugged and durable temperature probe has a sealed stainless steel shaft and tip that can be used in organic liquids, salt solutions, acids, and bases.

RANGE: -40 to 135°C

Extra-Long Temperature Probe

$79 ORDER CODE TPL-BTA

This probe has a 30-meter (100 ft) cable. It is designed for remote, outdoor temperature sensing or for measuring temperature at various depths in lakes and streams.

RANGE: -50 to +150°C

Go! Temp USB Temperature Probe

$39 ORDER CODE GO-TEMP

See page 27 for details.

GREAT WAYS TO USE THESE SENSORS!

CHEMISTRY
- Endothermic and exothermic reactions
- Freezing and melting of water
- Heat of fusion of ice
- Evaporation and intermolecular attractions

MIDDLE SCHOOL
- Heating of land and water
- The greenhouse effect

PHYSICS
- Newton's law of cooling

BIOLOGY
- Energy in food
- Biodiversity and ecosystems
- Aerobic respiration

PHYSICAL SCIENCE
- Boiling temperature of water
- Freezing temperature of water
- Insulation

Go Wireless® Temp

$75 ORDER CODE GW-TEMP

The Vernier Go Wireless Temp is a rugged, general-purpose, wireless temperature sensor you can use to remotely monitor temperature. Use with Bluetooth® Smart Ready devices, such as LabQuest 2 (model LQ2-LE) and iPad (3rd generation or newer).

USB charging cable is included. Free Graphical Analysis™ app for iOS and Android™ is available on the App Store and Google Play.

RANGE: -40 to 125°C
RESOLUTION: 0.07°C

Measuring the temperature of ice water

GREAT WAYS TO USE THESE SENSORS!

INNOVATIVE USES
- Science fair projects
- Monitor the temperature in your fish tank or greenhouse
- Measure the efficiency of a Thermos™
- Monitor environmental conditions
- Monitor the soil temperature of your outside plants
- Measure the temperature of the air coming from your air conditioner or furnace

Surface Temperature Sensor

$23 ORDER CODE STS-BTA

Featuring an exposed thermistor that results in an extremely rapid response time, the Surface Temperature Sensor is ideal for situations in which low thermal mass or flexibility is required, or for a skin temperature measurement. This design allows for use in air and water.

RANGE: -25 to 125°C

Infrared Thermometer

$169 ORDER CODE IRT-BTA

The Infrared Thermometer is a non-contact, fast-responding temperature measuring device. The sensor works by measuring the infrared radiation emitted by objects. You simply point the sensor at the object and read its temperature.

RANGE: -20 to 400°C
ACCURACY: ±3% of reading or ±3°C, whichever is greater at 18 to 28°C ambient operating temperature
EMISSIVITY: preset 0.95

GREAT WAYS TO USE THESE SENSORS!

CHEMISTRY
- Endothermic and exothermic reactions
- Freezing and melting of water
- Heat of fusion of ice
- Pressure-temperature relationship in gases
- Evaporation and intermolecular attractions

INFRARED THERMOMETER SENSOR

INNOVATIVE USES
- Measure the temperature of hard-to-reach objects
- Investigate skin temperature
- Compare the temperature of your palm, forearm, or foot
- Compare the temperature of cars parked in the sun

Temperature Probes (continued)

Wide-Range Temperature Probe

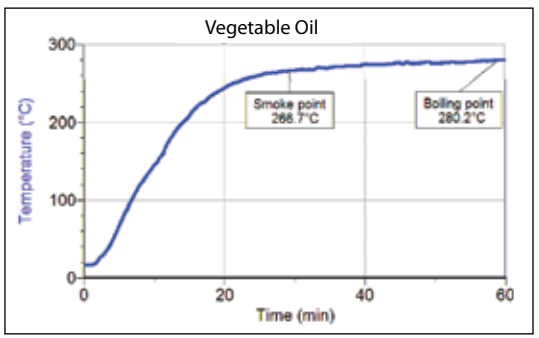
$79 ORDER CODE WRT-BTA

This temperature probe features a temperature range of -20°C to 330°C, which allows for melting point determinations of most organic compounds.

- Sealed, stainless-steel shaft can be used in organic liquids, salt solutions, acids, and bases.
- Long enough to extend into flasks and other common glassware.
- Diameter allows it to fit snugly in openings designed for thermometers.

RANGE SETTINGS: -20 to 330°C

ACCURACY: ±0.1°C throughout the temperature range



Temperature of warming vegetable oil using a Wide-Range Temperature Probe

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Fractional distillation
- Melting temperature of organic compounds
- Determining enthalpy of a chemical reaction
- Synthesis and analysis of aspirin

ORGANIC CHEMISTRY
- Determination of a boiling point
- The Diels-Alder reaction
- Fractional distillation of esters
- Isolation and epoxidation of a natural product
- Friedel-Crafts acylation of ferrocene
- Synthesis of fluorescein

Thermocouple

$69 ORDER CODE TCA-BTA

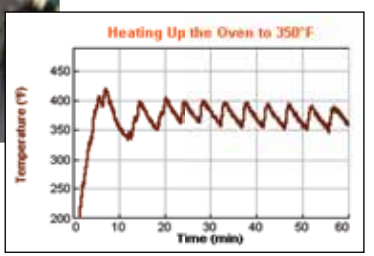
The Thermocouple uses type-K thermocouple wire to measure temperatures between -200˚C and 1400˚C.

- Measure liquid nitrogen temperatures at -196˚C and flame temperatures up to 1400˚C.
- Internal ice-point compensation means you do not need to place a reference wire in an ice-water bath.
- Individually calibrated.

RANGE:
-200 to 1400°C

TYPICAL ACCURACY:
0 to 900°C: ±2°C
-200 to 0°C: ±5°C
900 to 1400°C: ±15°C

Taking temperature of an open flame



Temperature cycles of an oven using a Thermocouple

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Compare the temperature at different parts of a flame
- Compare the temperature of different flames
- Temperature cycles of an oven
- Monitor temperature of liquid nitrogen or dry ice
- Determine the melting point of copper or other solids

Turbidity Sensor

$112 ORDER CODE TRB-BTA

Use the Turbidity Sensor to measure the turbidity of freshwater or seawater samples.

- Small, sleek design and simple setup make it easy to use at the collection site or in the classroom.
- Monitor precipitate formation or algae and yeast populations in chemistry and biology classes.
- Includes high-quality Hach StablCal™ 100 NTU standard for quick calibration and a high-grade glass cuvette for your water sample. A set of six additional glass Turbidity Bottles are available (ORDER CODE TRB-BOT, $27).

RANGE: 0 to 200 NTU

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.25 NTU
10-bit (CBL, CBL 2, NXT Adapter): 1.0 NTU

Measuring turbidity of a stream sample

GREAT WAYS TO USE THIS SENSOR!

WATER QUALITY
- Monitor water clarity

ENVIRONMENTAL SCIENCE
- Long-term water monitoring
- Pollution study

EARTH SCIENCE
- Water quality: turbidity
- Water treatment

UVA and UVB Sensors

$106 ORDER CODE UVA-BTA

$107 ORDER CODE UVB-BTA

We have two different sensors for measuring the intensity of ultraviolet radiation. One responds primarily to UVA radiation (320 to 375 nm), and another responds primarily to UVB radiation (290 to 320 nm). UVB radiation is commonly associated with sunburns, cataracts, and skin cancer. UVA radiation, while responsible for suntans, is also a cause of premature aging of the skin and some types of skin cancer. Which sensor you use will depend upon the particular experiment you want to perform.

UVA SENSOR
Great for use with UV lamps.

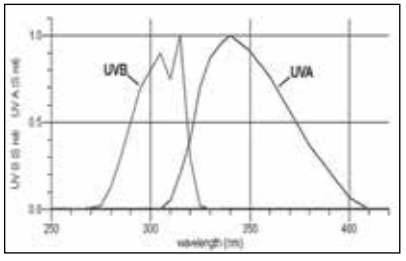
RANGE: 0 to 18,000 mW/m²
Wavelength sensitivity region approximately 320 to 375 nm
UV peak sensitivity: at 340 nm

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 5 mW/m²
10-bit (CBL, CBL 2, NXT Adapter): 20 mW/m²

UVB SENSOR
Great for use in the sun. Recommended for our lab books.

RANGE: 0 to 900 mW/m²
Wavelength sensitivity region approximately 290 to 320 nm
UV peak sensitivity: at 315 nm

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.25 mW/m²
10-bit (CBL, CBL 2, NXT Adapter): 1 mW/m²



Spectral response of the UV Sensors

GREAT WAYS TO USE THESE SENSORS!

EARTH SCIENCE
- Compare absorption in glasses
- Comparing sunscreens
- UV light and clothing

ENVIRONMENTAL SCIENCE
- Collect local weather data
- UV investigations

Voltage Probes

Differential Voltage Probe

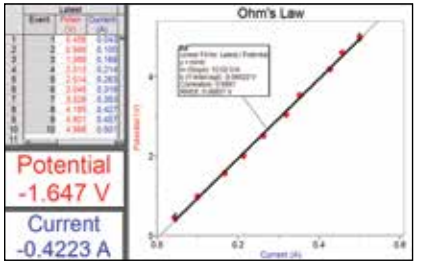
$39 ORDER CODE DVP-BTA

The Differential Voltage Probe is designed for exploring basic principles of electricity, including series and parallel circuits.

- Ideal for use in most battery and bulb circuits.
- Can be used to study low-voltage AC and DC circuits.
- Combine with a Current Probe to explore Ohm's law, phase relationships, and much more.

This sensor differs from our Voltage Probe (see next column) in that neither of the clips are grounded, making it possible to use two probes in the same circuit simultaneously.

RANGE: -6.0 to +6.0 V **INPUT IMPEDANCE:** 10 MΩ
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 3.1 mV
10-bit (CBL, CBL 2, NXT Adapter): 12.5 mV



Logger Pro graph showing Ohm's law using the Current Probe, Differential Voltage Probe, and the Vernier Circuit Board

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Ohm's law
- Series and parallel circuits
- Electrical energy
- Capacitors

PHYSICAL SCIENCE
- Battery and bulb investigations

INNOVATIVE USE
- For laboratory voltage measurement

Voltage Probe

$12 ORDER CODE VP-BTA

This Voltage Probe can be used to measure the potential in direct-current or alternating-current circuits. In chemistry, physical science, or middle school science classes, the Voltage Probe can be used to measure voltages developed in a variety of electrochemical (voltaic) cells.

RANGE: -10 to +10 V
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro): 0.005 V (5 mV)
10-bit (CBL, CBL 2): 0.020 V (20 mV)

30-Volt Voltage Probe

$49 ORDER CODE 30V-BTA

This sensor is used to measure voltages in the range of -30 to +30 volts. Use this sensor in experiments that involve voltages larger than 10 volts, such as when working with large solar panels. Since this voltage probe covers such a wide voltage range, its resolution is lower than our Differential Voltage Probe, which we recommend for most experiments.

RANGE: -30 to +30 V

GREAT WAYS TO USE THESE SENSORS!

VOLTAGE PROBE

CHEMISTRY
- Establishing a table of reduction potentials: micro-voltaic cell
- Lead storage batteries

PHYSICS
- Capacitor charging

MIDDLE SCHOOL
- Fruit and metal voltaic cells

30-VOLT VOLTAGE PROBE

INNOVATIVE USES
- Measure output from large solar panels
- Measure voltage in do-it-yourself projects
- Measure the output from KidWind turbines

Watts Up Pro

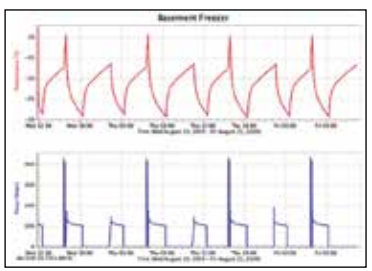
$145 ORDER CODE WU-PRO

Watts Up Pro measures real-time energy use of common electrical devices. Find out which costs more: running a hair dryer for 10 minutes or leaving on a lamp all afternoon? Measures potential, current, power, and cumulative cost.

- Connects to the USB port on your computer or LabQuest—no other devices needed.
- Use at the same time as a LabQuest, LabQuest Mini, LabPro, or Go!Link to monitor electricity usage in combination with other data, such as temperature, light, and relative humidity.
- The LCD panel on Watts Up Pro allows it to be used as a standalone device.

The Watts Up Pro carries a one-year warranty.

VOLTAGE: 120 V
MINIMUM MEASURABLE POWER: 0.5 watts
ACCURACY: ±1.5%, + 3 counts of the displayed value



Measuring temperature and power consumption in a basement freezer

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES

- Long-term monitoring of devices
- How can I save money?
- Investigate phantom load
- Compare energy use of different types of light bulbs
- Study energy use of different devices
- Analyze energy use of different wattage light bulbs
- Study energy use in charging electric cars

Wireless Dynamics Sensor System (WDSS)

$249 ORDER CODE WDSS

The WDSS combines a 3-axis accelerometer, force sensor, and altimeter into one unit that communicates wirelessly with your computer via Bluetooth®.

- Use it with your Bluetooth-enabled computer and Logger *Pro* to collect data free of friction due to cables.
- Internal data storage capacity allows you to use it as a standalone data logger. Great for roller coaster physics.

(Requires LabQuest 2 or a Bluetooth-enabled computer and Logger Pro *software. Can also be used with an original LabQuest with a Bluetooth dongle. See below.)*

INTERNAL DATA STORAGE CAPACITY: 240,000 points
MAXIMUM SAMPLING RATE: 1000 samples/s

FORCE	**RANGE:** ±50 N **RESOLUTION:** 0.006 N (<10 N) 0.03 N (>10 N)
ACCELEROMETERS *(for each axis)*	**RANGE:** ±60 m/s² (±5 g) **RESOLUTION:** 0.04 m/s²
ALTIMETER	**ALTITUDE CHANGE RANGE:** ±200 m **RESOLUTION:** 1 m

Bluetooth USB Dongle Radio

ORDER CODE **BLUE-USB, $35**

Each computer or original LabQuest used with a WDSS must have a Bluetooth radio. (Note: LabQuest 2 has a built-in Bluetooth radio.) This convenient USB dongle adds Bluetooth capabilities to any Windows XP SP2, Vista, or Mac OS X 10.3 or newer computer that lacks Bluetooth.

GREAT WAYS TO USE THIS SENSOR!

PHYSICS

- Roller coaster accelerations
- Skateboarding
- Newton's second law
- Newton's third law
- Centripetal acceleration on a turntable or a merry-go-round
- Force and acceleration in simple harmonic motion

PARTNERS

GLOBE
BIO-RAD
OHAUS
BODELIN
FLINN Flinn Scientific
NATIONAL INSTRUMENTS
ward's science
Independence Science
CASE Curriculum for Agricultural Science Education
TEXAS INSTRUMENTS
KidWind PROJECT
NATIONAL MATH + SCIENCE INITIATIVE
Ocean Optics
PROJECT LEAD THE WAY PLTW
LEGO education

"With Vernier, every telephone call—from ordering, asking a question, or having a sensor issue to solve—is handled capably and professionally with friendliness and good humor."

Cathy Theisen, Richfield High School, Richfield, MN

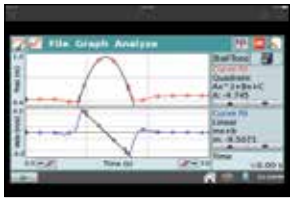
SENSOR ACCESSORIES AND REPLACEMENT PARTS

PART NAME	CODE	PRICE
Blood Pressure Sensor		
Small Blood Pressure Cuff	CUFF-SM	$32
Large Blood Pressure Cuff	CUFF-LG	$35
Bottles		
Nalgene Bottle *(250 mL)*	CO2-BTL	$3
Primary Productivity Kit	PPK	$44
Turbidity Bottles *(pkg. of 6)*	TRB-BOT	$27
Water Quality Bottles *(pkg. of 8)*	WQ-BOT	$28
Charge Sensor		
Electrostatics Kit	ESK-CRG	$109
High Voltage Electrostatics Kit	HVEK-CRG	$249
CO_2 and/or O_2 Gas Sensor		
BioChamber 250 *(250 mL) (2 openings)*	BC-250	$6
BioChamber 2000 *(2000 mL) (2 openings)*	BC-2000	$19
Grommets for CO_2 and O_2 *(pkg. of 10)*	CO2-GROM	$6
Respiration Chamber *(250 mL) (1 opening)*	CO2-BTL	$3
Colorimeter/Spectrometer		
Colorimeter/Spectrometer Cuvettes *(pkg. of 100)*	CUV	$15
Cuvette Rack	CUV-RACK	$9
Quartz Cuvettes *(pkg. of 2)*	CUV-QUARTZ	$159
Conductivity Probe		
Conductivity Low Standard *(500 mL)*	CON-LST	$16
Conductivity Medium Standard *(500 mL)*	CON-MST	$16
Conductivity High Standard *(500 mL)*	CON-HST	$16
Dissolved Oxygen Probe (Original)		
DO Calibration Solution *(60 mL)*	DO-CAL	$4
DO Filling Solution *(130 mL)*	FS	$6
DO Polishing Strips	PS	$4
DO Probe Membrane Cap	MEM	$13
Dissolved Oxygen Probe (Optical)		
Optical DO Probe Replacement Cap	ODO-CAP	$49
Optical DO Probe Metal Guard	ODO-GRD	$45
EKG Sensor		
EKG Electrodes	ELEC	$12
Electrode Amplifiers (BNC Electrodes)		
pH Electrode	PH-BNC	$41
Tris-Compatible Flat pH Electrode	FPH-BNC	$64
ORP Electrode	ORP-BNC	$39
Ethanol Sensor		
Ethanol Cap Assemblies *(pkg. of 3)*	ETH-CAPS	$10
Ethanol Stopper	ETH-STOP	$4
Ethanol Tape	ETH-TAPE	$3
Gas Pressure Sensor		
Pressure Sensor Accessories Kit	PS-ACC	$10
#1 1-Hole Rubber Stopper	PS-STOP1	$1

PART NAME	CODE	PRICE
Gas Pressure Sensor (continued)		
#5 2-Hole Rubber Stopper	PS-STOP5	$1.50
Luer Lock Connector	PS-LUER	$1
Plastic 2-Way Valve	PS-2WAY	$2
Plastic Tubing	PS-TUBING	$1
Plastic Tubing Clamps *(pkg. of 100)*	PTC	$32
Stopper Stem	PS-STEM	$1
Syringe (20 mL, plastic)	PS-SYR	$1
Go Wireless Sensors		
Go Wireless Charging Cable	GW-CB	$10
Go Wireless Charging Station	GW-CRG	$40
Go Wireless USB Radio	GW-RADIO	$29
Go Wireless Replacement Battery	GW-BAT-100	$7
Go Wireless pH Replacement Electrode	GW-PH-BNC	$40
Heart Rate Sensor		
Go Wireless Heart Rate Grip	HR-GRIP	$31
Go Wireless Heart Rate Strap	HR-STRAP	$21
Ion-Selective Electrodes		
ISE Ammonium Replacement Module*	NH4-MOD	$59
ISE Calcium Replacement Module*	CA-MOD	$59
ISE Nitrate Replacement Module*	NO3-MOD	$59
ISE Potassium Replacement Module*	K-MOD	$59
ISE Ammonium Low Standard *(500 mL)*	NH4-LST	$16
ISE Ammonium High Standard *(500 mL)*	NH4-HST	$16
ISE Calcium Low Standard *(500 mL)*	CA-LST	$16
ISE Calcium High Standard *(500 mL)*	CA-HST	$16
ISE Chloride Low Standard *(500 mL)*	CL-LST	$16
ISE Chloride High Standard *(500 mL)*	CL-HST	$16
ISE Nitrate Low Standard *(500 mL)*	NO3-LST	$16
ISE Nitrate High Standard *(500 mL)*	NO3-HST	$16
ISE Potassium Low Standard *(500 mL)*	K-LST	$16
ISE Potassium High Standard *(500 mL)*	K-HST	$16
Melt Station		
Melt Station Capillary Tubes *(pkg. of 100)*	MLT-TUBE	$15
Mini GC/Mini GC Plus		
GC Septa *(pkg. of 4)*	GC-SEP	$29
GC Syringe, 1 µL Hamilton	GC-SYR-MIC	$84
Motion Detector		
Motion Detector Clamp	MD-CLAMP	$7
Optics		
Color Mixer Kit	CM-OEK	$150
Diffraction Apparatus	DAK	$549
Mirror Set	M-OEK	$59
Optics Expansion Kit	OEK	$169
Polarizer/Analyzer Kit	PAK-OEK	$74

PART NAME	CODE	PRICE
pH Sensor		
Microstirrer	MSTIR	$9
pH Buffer Capsules	PHB	$12
pH Storage Bottles *(pkg. of 5)*	BTL	$10
pH Storage Solution *(500 mL)*	PH-SS	$16
Photogate		
Cart Picket Fence	PF-CART	$6
Laser Pointer	LASER	$19
Laser Pointer Stand	STAND	$14
Photogate Bar Tape Kit	TAPE-VPG	$17
Picket Fence	PF	$7
Pulley Bracket	B-SPA	$12
Ultra Pulley Attachment	SPA	$24
Polarimeter (Chemical)		
Polarimeter Sample Cells *(pkg. of 4)*	CELLS-POL	$66
Power Amplifier		
Accessory Speaker	PAAS-PAMP	$99
Rotary Motion		
Rotational Motion Accessory Kit	AK-RMV	$110
Rotary Motion Motor Kit	MK-RMV	$12
Centripetal Force Apparatus	CFA	$399
Salinity Sensor		
Salinity Standard *(35 ppt salinity, 500 mL)*	SAL-ST	$16
Spirometer		
Disposable Bacterial Filter *(pkg. of 10)*	SPR-FIL	$30
Disposable Mouthpiece *(pkg. of 30)*	SPR-MP	$10
Noseclip *(pkg. of 10)*	SPR-NOSE	$10
Spirometer Flow Head	SPR-FLOW	$60
O_2 Gas Sensor to Spirometer Adapter	O2-SPR	$8
Turbidity Sensor		
Turbidity Bottles *(pkg. of 6)*	TRB-BOT	$27
Turbidity Cuvette and Standard	TRB-ACC	$35
Vernier Dynamics System		
Bumper and Launcher Kit	BLK	$89
Fan Cart	CART-F	$94
Friction Pad	PAD-VDS	$30
Motion Encoder Fan Cart	CART-FEC	$199
Pulley Bracket	B-SPA	$12
Vernier Projectile Launcher		
Independence of Motion Accessory	IOM-VPL	$49
Projectile Stop	PS-VPL	$40
Time of Flight Pad	TOF-VPL	$77
Wireless Dynamics Sensor System Accessory		
Bluetooth USB Dongle Radio	BLUE-USB	$35

*ISE modules have a life expectancy of 1–2 years. We recommend that you do not purchase ISE replacement modules too far in advance of their expected time of use; degradation occurs while replacement modules are stored on the shelf.



$79 (a)

$15 (b)

$109 (c)

$109 (d)

$109 (e)

a. LabQuest Viewer

ORDER CODE **LQ-VIEW, $79**

LabQuest Viewer (electronic download*)

ORDER CODE **LQ-VIEW-E, $79**

Use this software to teach students how to use LabQuest by projecting your LabQuest screen via Wi-Fi. Use built-in Wi-Fi on LabQuest 2 to remotely monitor student progress by viewing student LabQuests. Compatible with both Mac and PC.

Computer software includes a site license for every teacher's computer in your school or college department.

LabQuest Viewer is also available for iPad. See page 32.

* Provide an email address to which we will send download information.

b. LabQuest 2 Lab Armor

ORDER CODE **LQ2-ARMOR, $15**

Add extra protection from spills and falls with Lab Armor for LabQuest 2. Molded rubber material helps prevent spills from getting into open ports.

c. LabQuest 2 Charging Station

ORDER CODE **LQ2-CRG, $109**

Multi-bay charging capability for your LabQuest 2. Each charging station has four charging slots.

d. Original LabQuest Charging Station

ORDER CODE **LQ-CRG, $109**

Multi-bay charging capability for your original LabQuest. Each charging station has four charging slots.

e. LabQuest Battery Boost 2

ORDER CODE **LQ-BOOST2, $109**

The Battery Boost 2 is a rechargeable external battery for your original LabQuest or LabQuest 2. Collect data for extended periods where AC power is not available.

ADDITIONAL ACCESSORIES

PART NAME	CODE	PRICE
LABQUEST 2 ACCESSORIES / REPLACEMENT PARTS		
LabQuest 2 Charging Station	LQ2-CRG	$109
LabQuest 2 Lab Armor	LQ2-ARMOR	$15
LabQuest 2 Stand	LQ2-STN	$5
LabQuest Computer Cable	LQ-CB-USB	$5
LabQuest Power Supply	LQ-PS	$11
LabQuest Tether *(pkg. of 5)*	LQ-TETH-5	$5
LabQuest Lanyard	LQ-LAN	$5
LabQuest 2 Battery	LQ2-BAT	$19
LabQuest Battery Boost 2	LQ-BOOST2	$109
LabQuest 4GB SD Card	LQ-SD4	$12
LabQuest 2 Stylus *(pkg. of 5)*	LQ2-STYL-5	$5
ORIGINAL LABQUEST ACCESSORIES / REPLACEMENT PARTS		
LabQuest Charging Station	LQ-CRG	$109
LabQuest Computer Cable	LQ-CB-USB	$5
LabQuest Power Supply	LQ-PS	$11
LabQuest Tether *(pkg. of 5)*	LQ-TETH-5	$5
LabQuest Lanyard	LQ-LAN	$5
LabQuest Battery	LQ-BAT	$19
LabQuest Battery Boost 2	LQ-BOOST2	$109
LabQuest 4GB SD Card	LQ-SD4	$12
LabQuest Stand	LQ-STN	$12
LabQuest Stylus *(pkg. of 5)*	LQ-STYL-5	$5
LabQuest Wi-Fi USB Adapter	WIFI-USB	$59
Vernier GPS Sensor	VGPS	$64
MISC. CABLES / ADAPTERS / POWER SUPPLIES		
AC Adapter *(for LabPro, CBL 2, or CBL)*	IPS	$12
Analog Sensor Extension Cable *(2 m)*	EXT-BTA	$12
Digital Sensor Extension Cable *(2 m)*	EXT-BTD	$12
Analog Protoboard Connector	BTA-ELV	$10
Digital Protoboard Connector	BTD-ELV	$10
Calculator-to-Calculator Link Cable	TI-CLC	$5
Short Calculator Link Cable	TI-SLC	$5
Go!Motion to Computer Cable	GMC-USB	$5
LabPro→USB Cable *(Mac or PC)*	CB-USB	$5
Analog Bare Wire Cable	CB-BTA	$5
Digital Bare Wire Cable	CB-BTD	$5
Mini-to-Standard USB Adapter	MINI-USB	$10
Motion Detector Cable *(LabQuest, LabPro or CBL)*	MDC-BTD	$5
Standard-to-Mini USB Adapter	USB-MINI	$5

MORE ONLINE – Can't find the adapter you need? Check our complete list of adapters (including pictures) at **www.vernier.com/adapters**

PROFESSIONAL DEVELOPMENT

About Our Trainers

Vernier's Professional Training Staff includes

- 36 current or former classroom science and math teachers, all of whom have used Vernier equipment and software in their own classes
- Teachers who, as a group, possess a total of 856 years of teaching experience, encompassing all subject areas and grade levels
- Educators with prestigious teaching awards in their respective states and teaching subject areas, including six Presidential Awardees, one Woodrow Wilson Dreyfus Master Teacher, three Tandy Technology Scholars, one Radio Shack Technology Awardee, one Da Vinci Science Center Hall of Fame Master Teacher, two GTE Gift Awardees, one Excellence in Pre-College Physics Teaching Awardee, and a variety of science educator of the year recipients, as well as many other awards
- Authors of more than 60 science books and lab manuals (including many of our own Vernier lab books)

IMPROVING TEACHER EFFECTIVENESS

Data-collection training gives teachers the skills to teach with the latest in sensor technology. All teachers will conclude their Vernier training with a certificate of completion indicating the number of hours spent in training. For more information on probeware and student achievement, see pp. 4–5.

Graduate Education Credit Available

NEED TO EARN CREDIT?

Attend one of our workshops that is four hours or longer and you will have the opportunity to earn two (quarter) Graduate Science credit hours through the Portland State University Center for Science Education. For more details on this professional development option, see **www.vernier.com/gradcred**

Many states offer continuing education credit or clock hours for attendance at workshops held at professional conventions or at in-service training. We are happy to provide documentation of your attendance at any of our hands-on or demonstration workshops, hundreds of which are offered throughout the country each year. For more details, contact us at **pd@vernier.com**

FREE Hands-On, Data-Collection Workshops

LabQuest 2 | Computer Data Collection

4 HOUR

Calling all science educators! Step out of your classrooms, roll up your sleeves, and join us in the Vernier laboratory for a four-hour exploration of the latest and greatest in probeware and data-collection technology. Learn how to integrate our technology into your chemistry, biology, physics, middle school science, physical science, and Earth science curriculum. Register online at **www.vernier.com/free-workshops**

Perfect for science educators interested in

- Evaluating our award-winning, data-collection technology
- Getting started with probeware and data collection
- Refreshing their knowledge of Vernier equipment
- Learning from experts

Attendees receive

- Four hours of free training
- Light lunch or dinner
- Workshop Training Manual download
- Discount on LabQuest 2 Training Package or LabQuest Mini Training Package

2015 HANDS-ON, DATA-COLLECTION WORKSHOPS

SPRING WORKSHOPS	
Alabama	Huntsville
Arizona	Phoenix
Arkansas	Little Rock
California	Pasadena, Riverside, San Francisco, Santa Clara
Connecticut	Hartford, Stamford
Delaware	Wilmington
Florida	Ft. Lauderdale, Jacksonville, Orlando, Tampa
Georgia	Atlanta, Marietta
Louisiana	Baton Rouge
Maryland	Baltimore
New Jersey	Newark, Princeton
New York	Long Island, Westchester County
North Carolina	Charlotte, Greensboro, Raleigh/Durham
Pennsylvania	Philadelphia
South Carolina	Charleston
Tennessee	Knoxville, Memphis, Nashville
Virginia	Arlington, Richmond

FALL WORKSHOPS	
Illinois	Chicago
Indiana	Indianapolis
Iowa	Cedar Rapids
Kansas	Wichita
Kentucky	Lexington, Louisville
Massachusetts	Boston, Worcester
Michigan	Detroit, Grand Rapids
Minnesota	Minneapolis
Missouri	Kansas City, St. Louis
Nebraska	Omaha
New Hampshire	Manchester
New York	Albany, Buffalo, Syracuse
Ohio	Cincinnati, Cleveland
Oklahoma	Oklahoma City, Tulsa
Pennsylvania	Pittsburgh
Texas	Austin, Dallas, Fort Worth, Houston, San Antonio
Wisconsin	Green Bay, Madison, Milwaukee

Summer Institutes: Data Collection

LabQuest 2 | Computer Data Collection

1 DAY

In this six-hour workshop, you will get hands-on experience with Vernier's award-winning line of computer and handheld data-acquisition technology. One of our knowledgeable training specialists will work right alongside you, providing guidance and inspiration as you explore classroom-ready labs.

You'll leave the workshop ready to integrate our data-collection technology into your chemistry, biology, physics, middle school science, physical science, and Earth science curriculum. The $99 registration fee includes lunch, access to lab handouts, and a lab manual of your choice. Please see the website for Training Package pricing.

Register online at **www.vernier.com/summer-institutes/**

JUNE	JULY	AUGUST
Oklahoma City, OK	Denver, CO	Beaverton, OR
Dallas, TX	Salt Lake City, UT	Seattle, WA
Houston, TX	St. Louis, MO	
	Chicago, IL	
	Columbus, OH	
	Philadelphia, PA	
	New York, NY	
	Boston, MA	

MORE ONLINE – Information available at **www.vernier.com/training**

FREE Hands-On Training at Conferences

Vernier will offer hands-on workshops at each of these conferences. For a complete list of our conference exhibits, check our website at **www.vernier.com/conferences**

- **Florida Education Technology Conference,** Orlando, FL, January 20–23
- **Texas Computer Education Association,** Austin, TX, February 2–6
- **NSTA National Conference,** Chicago, IL, March 12–15
- **NSTA STEM Forum & Expo,** Minneapolis, MN, May 20–23
- **International Society for Technology in Education,** Philadelphia, PA, June 28–July 1
- **American Association of Physics Teachers,** College Park, MD, July 25–29
- **NSTA Area Conference,** Reno, NV, October 22–24
- **National Association of Biology Teachers,** Providence, RI, November 11–14
- **NSTA Area Conference,** Philadelphia, PA, November 12–14
- **Conference for the Advancement of Science Teaching,** Fort Worth, TX, November 12–14
- **NSTA Area Conference,** Kansas City, MO, December 3–5

VERNIER WORKSHOP IN BEAVERTON

We can conduct a one-day workshop at our office specially designed for you. The workshop can be training only (no charge) or it can include equipment as part of the cost. For information, go to **www.vernier.com/workshops-at-vernier**

VERNIER WORKSHOP AT YOUR SCHOOL

We can come to your school to do a one-day, hands-on workshop using your Vernier equipment. This workshop can be computer or handheld-based data collection, in any science subject. The fee is $1,600, which includes travel expenses (in the continental U.S.). More information and an on-site workshop application can be found on our website at **www.vernier.com/workshops-at-school**

ADDITIONAL WORKSHOPS

For information on independent workshops that provide instruction in the use of Vernier products, go to **www.vernier.com/training/independent**

PERSONALIZED WEBINARS

We offer free, personalized webinars for your entire department that can focus on basic or advanced use in any subject area. Webinars are easy to set up and are flexible enough for your busy schedule. **www.vernier.com/webinars**

CANADIAN WORKSHOPS

Presented by Merlan Scientific

Let Merlan Scientific customize a Vernier workshop for your school! We know that opportunities for teacher PD are limited, and we can help you make the most efficient use of your valuable time. Request a customized workshop quote today! Contact us at 1-800-387-2474 | info@merlan.ca | **www.merlan.ca**

CHAUTAUQUA SHORT COURSE

Promoting Active Learning in Introductory Physics Courses with Research-Based Curricula and Tools

This hands-on course is designed for those who teach introductory physics at universities, colleges, and high schools. Graduate credit will be available.

June 18–20, 2015
Vernier Software & Technology, Beaverton, OR

Instructors: Priscilla Laws (Dickinson College), David Sokoloff (University of Oregon), Ronald Thornton (Tufts University)

For more information and to register go to **http://pages.uoregon.edu/sokoloff/CHAUT.htm** or contact David Sokoloff, sokoloff@uoregon.edu, 541-221-6543

Subject-Specific Institutes

2 DAYS

These two-day workshops will be held in Beaverton, Oregon, at the Vernier office. The $199 registration fee includes lunch and a Vernier lab book. You may also be able to earn graduate or continuing education credit through Portland State University.

AP* CHEMISTRY

- *For beginner, intermediate, and advanced users*
- *July 6–7, 2015*
- *Includes a copy of the lab book,* Vernier Chemistry Investigations for Use with AP Chemistry, *a $48 value*

During this two-day, hands-on workshop, you will explore how to integrate probeware into your AP Chemistry courses. Special emphasis will be placed on conducting inquiry investigations featuring experiments from our new AP Chemistry lab book.

Examples of experiments and sensors that will be covered

- Acid-Base Titration: Determining the K_a of a Weak Acid – pH Sensor
- Determining the Rate Law of a Chemical Reaction – SpectroVis Plus
- Identifying an Unknown Solid by Melting Temperature – Melt Station
- A Redox Titration – Oxidation-Reduction Potential (ORP) Sensor
- Analyzing a Mixture with a Gas Chromatograph – Mini GC Plus

*AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.

ENVIRONMENTAL SCIENCE/ AP ENVIRONMENTAL SCIENCE

- *For beginner, intermediate, and advanced users*
- *July 8–9, 2015*
- *Includes a copy of the lab book,* Investigating Environmental Science through Inquiry, *a $48 value*

This two-day, hands-on workshop gives you the opportunity to explore how to integrate probeware into your environmental science course. Participants will conduct experiments that investigate ecology, field biology, and renewable energy. A variety of experiments that are correlated to the AP Environmental Science framework will be offered. Specific emphasis will be placed on conducting inquiry investigations.

A variety of investigations and sensors will be covered, including

- Microclimates – PAR Sensor, Temperature Probe, UVB Sensor
- Primary Productivity – Optical DO Probe
- Water Quality Testing – Optical DO Probe, Conductivity Probe, pH Sensor
- Exploring Wind Turbines and Solar Panels – Energy Sensor, Variable Load

BIOLOGY/AP BIOLOGY

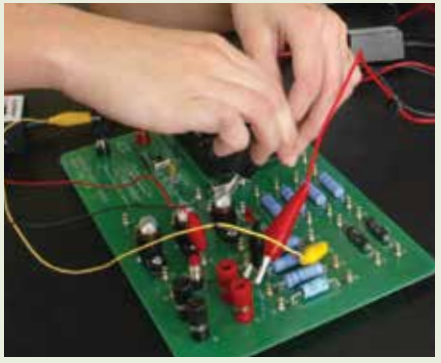
- *For beginner, intermediate, and advanced users*
- *July 10–11, 2015*
- *Includes a copy of the lab book,* Investigating Biology through Inquiry, a *$48 value*

This two-day, hands-on workshop gives you the opportunity to explore how to integrate probeware into your biology courses. You will have the option to conduct experiments in human physiology, ecology, and cellular biology. A variety of experiments that are correlated to the AP Biology framework will be offered. Specific emphasis will be placed on conducting inquiry-based laboratory investigations.

Experiments and sensors include

- Cell Respiration – CO_2 Gas Sensor
- Testing Catalase Activity – Gas Pressure Sensor
- Transpiration – Gas Pressure Sensor
- Analysis of Enzymes using Peroxidase – SpectroVis Plus Spectrophotometer
- The Visible Spectra of Plant Pigments – SpectroVis Plus Spectrophotometer
- Primary Productivity – Optical DO Probe
- Heart Rate – Hand-Grip Heart Rate Monitor

2 DAYS



PHYSICS

- *For beginner, intermediate, and advanced users*
- *July 14–15, 2015*
- *Includes a copy of the lab book,* Physics with Vernier*, a $48 value*

This two-day, hands-on physics workshop gives you the opportunity to explore data collection and video tools offered by Vernier. You will learn basic and advanced skills in Logger *Pro*, such as configuring graphs, performing custom curve fits, setting up calculated columns, and customizing data-collection modes. Video analysis using computers and tablets will be covered. A variety of Vernier interfaces and applications will be available, including LabQuest 2, LabQuest Mini, iOS, Android™, and Chrome™ apps.

Topics include

- Dynamics and kinematics using the Motion Encoder Cart, Encoder Fan Cart, and the Vernier Dynamics System
- Optics and diffraction using the Optics Expansion Kit and the Diffraction Apparatus
- Circuits using the Vernier Circuit Board

1 DAY

These one-day workshops will be held in Beaverton, Oregon, at the Vernier office. The $99 registration fee includes lunch and a Vernier product. You may also be able to earn graduate or continuing education credit through Portland State University.

ENGINEERING AND STEM WITH LOGGER *PRO*

- *For intermediate users who have some experience using Logger* Pro
- *July 16, 2015*
- *Includes a Vernier Digital Control Unit, a $61 value*

Explore several ways to use Logger *Pro* software and Vernier technology to introduce STEM and engineering during this one-day, hands-on workshop.

In the morning, you will learn how a Digital Control Unit (DCU) can be used to develop logic-based, sensor-control systems. Some of the exercises you will perform are

- Controlling inexpensive DC devices (motors, buzzers, LEDs, and others) with the DCU
- Creating an automated, sensor-controlled apparatus

In the afternoon, you will have a choice of two topics:

Option A - Using the Vernier Structures & Materials Tester

You will learn how to conduct an engineering lesson moving from basic concepts of geometry and design, through testing of small components, and capping it off with a bridge or truss design contest.

Option B - Building and Calibrating Your Own Sensors

You will build simple sensors and learn how to calibrate them for use with Logger *Pro*. Examples include temperature, force sensors, and photogates.

Note that the Arduino workshop is on the day following this workshop. Consider attending it, if you are interested in further training on engineering education topics.

VERNIER SENSORS WITH ARDUINO™

- *For intermediate users*
- *July 17, 2015*
- *Includes a SparkFun® Arduino RedBoard and a Vernier Interface Shield, a $50 value*

The availability of inexpensive, easy-to-program microcontrollers, such as Arduino, make engineering projects easy and affordable. Arduinos are a great tool for getting students (and teachers) excited about engineering. This one-day, hands-on workshop gives you the opportunity to explore different ways to use your Vernier sensors with an Arduino.

You will learn the fundamentals of programming the Arduino and be introduced to the sample code available on our website.

Some of the topics that will be included are

- Connecting and calibrating Vernier sensors
- Writing programs (called sketches for Arduino) to read Vernier sensors
- Logging data with Arduino and exporting data to Logger *Pro* for analysis
- Creating interactive Arduino projects

Contests and Grants

ENGINEERING CONTEST

Are you using Vernier sensors to teach engineering concepts or engineering practices in the classroom? If you are, you could win one of three $5,500 awards (one for middle school, one for high school, and one for college).

Maybe your students are using Vernier sensors to test a design project. Or maybe you are challenging your students to build an automated device using the Vernier Digital Control Unit (DCU) and Logger *Pro* software. Perhaps your students are writing NI LabVIEW or ROBOTC code to read a Vernier sensor from a robotics platform such as LEGO, VEX, or Arduino. Tell us about your projects, and you might win!

Each award will consist of $1,000 in cash, $3,000 in Vernier technology, and $1,500 toward expenses to attend either the annual NSTA STEM conference or the annual ASEE conference. For complete rules and to submit an online application and video showcasing your entry, go to **www.vernier.com/grants/engineering**

VERNIER / NSTA TECHNOLOGY AWARD

Award of $5,500 in Prizes for Each Teacher

Full-time science teachers from elementary to college level are eligible to apply for the Vernier Software & Technology/NSTA Technology Award. Vernier will provide up to seven awards, each valued at $5,500, for educators who demonstrate innovative uses of data-collection technology using a computer, graphing calculator, or other handheld device in the science classroom.

The awards will be given to one elementary teacher, two middle school teachers, three high school teachers, and one college-level educator. Each will receive a $1,000 cash award, $3,000 in Vernier equipment, and $1,500 towards travel and expenses to attend NSTA's National Convention in 2016.

For guidelines, a grant application, and profiles of previous winners, go to **www.vernier.com/grants/nsta**

"Technology is needed…not just to give students exposure to the technology or to satisfy parents; technology greatly improves learning and supports science education standards that are difficult to teach without using technology."

Metcalf, S. J., & Tinker, R. 2003
TEEMSS: Technology Enhanced Elementary and Middle School Science, *Annual Meeting of the National Association for Research in Science Teaching March 23–26, 2003, Philadelphia*

NABT ECOLOGY/ENVIRONMENTAL SCIENCE TEACHING AWARD

The NABT Ecology/Environmental Science Teaching Award will be granted to a secondary school teacher who has successfully developed and demonstrated an innovative approach in the teaching of ecology/environmental science and has carried his/her commitment to the environment into the community.

Each award consists of a one-year complimentary NABT membership, award plaque, $500 in Vernier technology, and $1,000 toward expenses to attend the NABT Professional Development Conference. For complete rules and to submit an online application, go to **www.vernier.com/grants/nabt**

VERNIER GRANT WRITING GUIDE

Looking to fund a state-of-the-art science lab? Vernier has gathered a variety of tips for writing a winning grant proposal.

The Vernier Grant Writing Guide includes

- Supporting Your Vision
- Identifying Your Funding
- Writing Your Proposal
- Putting It All Together
- Supporting Your Proposal
- Following Up on Your Grant

This guide will help you write a successful grant proposal.

MORE ONLINE – Download the Vernier Grant Writing Guide at **www.vernier.com/grants**

"I love Vernier for the fact that when you call for help, you talk to real people, in real time, and you don't have to listen to a long list of menu options which may have changed."

Gary Patterson, Vincennes University, Vincennes, IN

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NI LabVIEW for Education, Davis WeatherLink, WeatherLink IP for Vantage Pro, ProScope HR software, and software from Texas Instruments are licensed under separate agreements by their respective companies.

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We are readily available to help you with individual questions about our software and hardware—simply email support@vernier.com or call us on our toll-free number: 888-VERNIER (888-837-6437).

We publish a periodic newsletter, *The Caliper*, with information on upgrades, suggestions for new ways to use our programs, and announcements of new products.

PREVIEW POLICY

Most Vernier products are available for a 30-day preview (or longer, if requested) to educational institutions.

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Any product that does not meet your needs may be returned within 30 days for a full refund, subject to the Equipment Return policy. Equipment returned after 30 days may be subject to a restocking fee.

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Vernier products are designed for educational use. Our products are not designed nor are they recommended for any industrial, medical, or commercial process, such as life support, patient diagnosis, control of a manufacturing process, or industrial testing of any kind. We design our products with the specifications and features that educators and students need to be successful. In our effort to keep our products affordable and easy to use, we may not meet the specifications or include the features that an industrial scientist or medical professional might want.

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Vernier has been selling science software and data-collection hardware since 1981. We pride ourselves on the quality and affordability of our products and our service to our customers. If, at any time, you are unhappy with any of our products or service, please call, write, or email.

Vernier Software & Technology, 13979 SW Millikan Way, Beaverton, OR 97005-2886 | **www.vernier.com**
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We've Gone Green

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ is the nationally accepted benchmark for design, construction, and operation of high-performance green buildings. Here are just a few examples of our practices:

SOLAR PANELS – We have installed 17,000 watts of solar panels.

ALTERNATIVE TRANSPORTATION – All employees are provided with free transit passes and are encouraged to walk, bike, carpool, or take public transport to work.

RECYCLING – We recycle everything we can: paper, plastic, aluminum, cardboard, CDs, and more.

WORM BIN COMPOSTING – Vernier employees compost food scraps and yard clippings using a colony of red wiggler worms.

ELECTRIC CAR CHARGING STATIONS

PACKING MATERIALS – Employees use boxes and packing materials over and over again.

LIGHTING – We've installed energy-saving compact fluorescent and LED bulbs in most of our fixtures.

LEED-EB GOLD RATING – In 2006, our building qualified for the second highest rating possible from the U.S. Green Building Council with 50 points.

Meet Some of the Vernier Tech Support Team

When you call Vernier, you'll speak with people devoted to science education—scientists, educators, and engineers who are passionate about working with teachers and helping students succeed.

Outside of work, our team members enjoy a variety of hobbies including music, soccer, beekeeping, kayaking, snowboarding, travel, and baseball.

To learn more about what they do for fun, visit **www.vernier.com/team**

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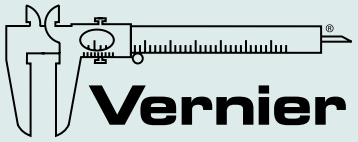

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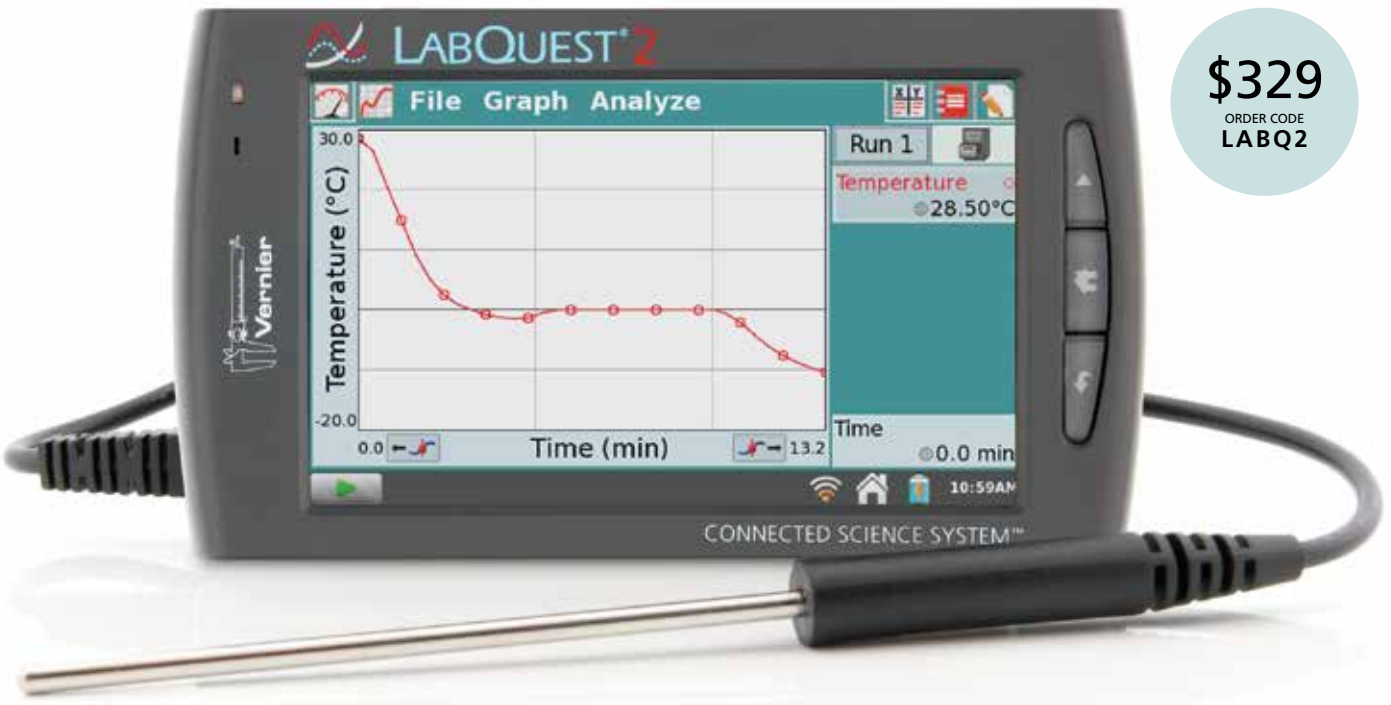

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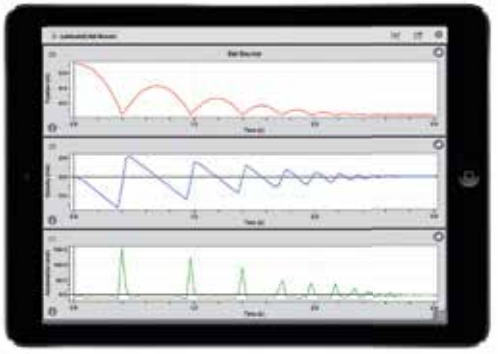

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